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JUN 1 1906

SCIENTIFIC AMERICAN

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Vol. XCIV.—No. 22.
ESTABLISHED 1845.

NEW YORK, JUNE 2, 1906.

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Bird's Eye View, Showing the Vast Area, 2,050 Feet by 500 Feet, Which is Being Excavated to a Depth of 50 Feet, Necessitating the Removal of 2,000,000 Cubic Yards of Material.

ACRES OF VALUABLE LAND IN THE HEART OF NEW YORK CITY LAID WASTE FOR THE NEW PENNSYLVANIA RAILROAD STATION.—[See page 488.]

SCIENTIFIC AMERICAN
ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at
No. 361 Broadway, New York

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NEW YORK, SATURDAY, JUNE 2, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE RAPID TRANSIT EAST RIVER TUNNEL DEFECTS.

In accordance with a resolution of the Rapid Transit Board at its last meeting, when the Mayor suggested that there had been a lack of publicity in respect of the defects in the East River Rapid Transit tunnel, the chief engineer, Mr. George S. Rice, has presented a report which fully explains the conditions on this important piece of work.

It seems that there was no serious trouble in driving the tunnel and maintaining the correct grade, until the shield had passed below the water level of the East River, when water was encountered in considerable quantities, and the shield began to settle below the established grade. The settlement was immediately detected by the Rapid Transit engineers, reported to the chief, and by him was reported to the Board, and from that date to the present, the conditions in the tunnel have been regularly made known at successive Board meetings.

The cause of the trouble was the failure of the subcontractor to maintain sufficient air pressure at the shield to keep out water, and so preserve the ground through which the shield was being driven in a proper condition to support the weight of the shield, amounting to about 50 tons. Instead of maintaining the pressure sufficiently high to keep the shield free of water, which might have been done by increasing the supply of air, or by the use of special devices intended to diminish the loss of air, the contractor preferred to keep down the excess of water in the shield by pumping.

In other words, instead of preventing the water from flowing into the shield, he preferred to let a certain amount of flow take place, and remove the water by running a suction hose to the bottom of the forward edge of the shield and pumping it out through the tunnel. Now, while this method was successful in keeping the water down, it had this unfortunate effect, that the water, flowing around the under sides of the shield toward the suction hose, washed along with it the underlying sand, causing a cavity beneath the shield. This produced the condition that the shield and a certain amount of the forward end of the tunnel were pressed down by the heavy load of sand and water above it, while there was no corresponding sand to support the overhanging structure from beneath. This brought a heavy vertical bending strain upon the forward end of the shield and tunnel lining, causing it to settle gradually even when it was not being advanced. The bending strain also cracked the plates, and resulted in those depressions in the line of the tunnel which must now be remedied.

It was realized that it would be possible to rectify these errors of grade subsequently while the rest of the tunnel was being constructed, and this reconstruction is now being carried out on a length of 1,800 feet in the north tube and 700 feet in the south tube. This reconstruction involves the lowering of the track or the replacing of plates in the bottom or top of the tube, according to the conditions. These repairs will be completed by the time the river headings are driven to a connection, which will probably occur during next November.

The Brooklyn tunnel is being driven through a glacial drift consisting of sand mixed with bowlders, and some gravel. The public may be perfectly satisfied as to the permanent stability of the tunnel. The report states that the material which the engineers have encountered under the river is such that when the tunnel is completed, it can be absolutely relied upon to stay in place.

PRESENT CONDITIONS AT PANAMA.

The chairman of the Isthmian Canal Commission, at the close of his last report giving a summary of the work that has been done on the canal, states that the carrying through of this great work divides itself into two parts—first, that of thorough preparation; and second, that of actual construction; and he says with great truth that the former is the more important and more difficult of the two. Like many of the colossal tasks involving the movement, sustenance and control of large bodies of men in climates to which they are unsuited and unaccustomed, this enterprise has suffered from a reversal of the proper order of procedure as stated above. In the desire to "make the dirt fly," actual construction was begun before adequate preparation had been made. Men from northern climes were sent into a fever-laden district, where there was no provision to adequately house and feed or employ them, to say nothing of the lack of those hygienic safeguards which are indispensable, if the white man from more temperate zones is to live and work in a tropical region.

The policy inaugurated by the chairman in the late summer of 1905 included the closing down of the work of excavation, except so far as it was necessary to put the cuts in condition for the installation of the maximum number of steam shovels that could be economically employed, and the direction of the energies of the force to that general work of preparation which should have antedated any serious attempt at construction. The work of preparation has included the creation of an effective working organization; the sanitation of the Isthmus; the provision of suitable quarters and food for employees; the construction of proper terminal, yard, and railway track facilities, and intermediate yards suitably disposed along the line of the canal for the handling of the vast quantities of supplies and material; the installation of a system of parallel working tracks laid through the cuts; and finally, the working out of all engineering problems and formulation of a comprehensive plan for carrying forward the work in each department.

The health conditions on the Isthmus are to-day most satisfactory. Although there are 23,000 employes on the payrolls, there are fewer patients in hospitals than for many months past, 450 beds being vacant. There has been no authentic case of yellow fever since last November. Mosquitoes are so scarce that many people sleep in unscreened houses. Indeed, Dr. Gorgas considers that he has the health situation so well in hand, that no epidemic can arise within the canal zone.

In regard to food and quarters for employes, we learn that the building department has not only provided ample quarters for the existing force, but has at the present time a sufficient reserve to accommodate 3,000 additional laborers. An interesting side light is thrown upon the character of the native laborers in the canal zone by the fact that although mess kitchens have been created at the different labor camps where wholesome and nourishing meals may be obtained at the cost of ten cents each, the laborers did not avail themselves of the privilege, except in small numbers. This was due, not to a desire to save, but to indulge in food unsuited to their physical needs, and to gratify their desire for drink and other indulgences. To meet this condition the chief engineer was authorized to insert in all future labor contracts a proviso, whereby the employe agrees to permit a fixed amount to be deducted from his daily wage, in consideration of which he is to receive three wholesome and nourishing meals per day. With regard to the food supply of American employes, we learn that modern refrigerator cars are now running on the Panama Railroad; that there is a cold-storage plant in operation at Colon, and that refrigerating plants have been installed on two of the steamers running between New York and Colon. A continuous line of refrigeration, therefore, exists between all points in the United States and the various districts within the canal zone. The first consignments of American meats and vegetables have been successfully distributed along the canal.

Another preparatory work which is nearing completion is the creation along the line of the canal of proper yard and track facilities for receiving and distributing the vast amounts of supplies needed for the canal, and to provide for the disposal of the millions of cubic yards of excavated material, as it is brought out from the cuts. The large terminal yard at Cristobal is nearly completed, as are the machine and erecting shops, coaling stations, turntable, etc., while the receiving and forwarding yards at Bas Obispo and Pedro Miguel, on each side of the Culebra cut, which will receive the dirt trains as they come down from the levels of Culebra cut, are well under way. Several miles of the double-tracking of the Panama Railroad main line have been completed, and the grading for more of it is well advanced.

The great Culebra cut has been put in shape for the approaching wet season, with a view to the installation of the largest possible number of steam shovels. All the barriers left across the cut by the French have been removed; tracks have been laid and ballasted on each level of the cut, and a well-ballasted, double-track line has been built through the bottom of the canal prism. The chief engineer believes that by July or August he will have forty steam shovels installed and will be removing about 1,000,000 cubic yards per month. The actual cost of excavation during March was 53½ cents a cubic yard.

Finally, and by no means least important, is the announcement by the chairman of the Canal Commission that law and order continue to be maintained to a degree that would be remarkable under any conditions, and is especially so when the character of the population of the zone is considered; for its vast army of 23,000 employes has been gathered from all parts of the world. Under the administration of the Canal Zone Governor, the police force is so vigilant and so efficient that good order is steadily maintained, serious crime is almost unknown, and arrests are mainly for petty offenses and violations of the sanitary laws.

As matters now stand there is an urgent call from the Isthmus for an early decision as to the type of canal to be built, the preparatory work having reached the stage at which, if a plan of construction be not quickly decided upon, a large part of the engineering and constructive force must remain idle.

RECENT EXPERIMENTS IN THE PRESERVATION OF MEAT.

In a report by the Italian Minister of Agriculture on the subject of refrigerating in Italy, Mancini gives some interesting results obtained by the Craveri process for preserving meat, a process which was much discussed some months ago, but of which a more definite idea can now be formed, since a series of experiments has been conducted under the direction of a number of university professors.

The Craveri method would seem to have solved the problem hitherto unsolved—of preserving meat in a form fit to be eaten, by means of chemical treatment. Excluding for hygienic reasons ordinary antiseptics, and recognizing as insufficient for practical purposes the usual method of salting, Craveri resorts to injections into the veins of slaughtered animals, from which the blood has been drained, of a solution of 100 parts of water, 25 of kitchen salt, and 4 of acetic acid; in other words, of a solution of a mixture of substances such as are found normally in our bodies, and which form part of our nourishment. The solution is injected to the amount of one-tenth of the weight of the living animal. Prof. Brusaferro, of Turin, experimented upon two animals, a sheep and a calf; the two carcasses were hung in a subterranean room for 75 days, at a temperature of 16 deg. C. (about 61 deg. F.). After this time they were skinned, dressed, and cut up. The heart, brains, liver, and intestines seemed somewhat macerated, but were normal in appearance. The fat beneath the skin was perfectly preserved, the flesh appearing bright red in color, moist, and giving out an agreeable, slightly acid odor. In no part was there any trace of putrefaction, even incipient. This meat boiled produced an excellent broth, resembling in every particular that obtained from fresh meat. Roasted it was tender, and even tasted better than ordinary meat, was digestible and nutritious. As a result of these and other experiments, Prof. Brusaferro declares it as his opinion that the Craveri method promises great advantages over others. The other professors engaged in the experiments came to exactly the same conclusions. Submitted to a bacteriological examination, the meat proved to be free from bacteria; in the long period of preservation given, the beginning of dissolution was noticed in the visceral and muscular tissues, but without the production of any toxic principle whatever.

DENATURED ALCOHOL FREED FROM TAXATION.

On May 24 the Senate passed by a unanimous vote the bill which provides for the freeing from taxation after January 1, 1907, of denatured alcohol used for industrial purposes. The bill had previously been passed by the House, where it was opposed chiefly by the manufacturers of wood alcohol. This substance is to be used as an adulterant, however, to make the alcohol unfit for drinking. According to the provisions of the new law, the adulterating or denaturizing of the alcohol is to be done in the various factories under the supervision of an internal revenue officer.

By removing the tax from industrial alcohol our government has effectually put a stop to the domination of the oil trust over the use of liquid fuel for light, heat, and power. In Germany and France devices for using denatured alcohol for these purposes have already been perfected and placed in actual use, and their adoption in this country will no doubt come quickly as soon as industrial alcohol is on the market. As this fuel can be produced from many vegetable products that have heretofore gone to waste, and that, too, at a considerably lower price than is obtained for gasoline and kerosene to-day, there need never be any fear of lack of fuel, even should the coal measures all become exhausted and the supply of natural oil cease.

The new fuel, besides being cleaner and less volatile, will, when used in suitably-designed internal-combustion motors, develop about as much power per gallon as will the old, while for light and heat it is far superior. Its introduction will create a new market for the farmers of our country, while they will benefit directly from it also by using it themselves for the production of light and power.

THE HEAVENS IN JUNE.

BY HENRY NORRIS RUSSELL, PH.D.

Our map shows the sky as it appears in the early evening, just after dark. The brightest star in sight is Arcturus, which is due south, and very high up. About it lie the other stars of Boötes, the Herdsman, which can be easily picked out with the aid of the map. The star Epsilon (ε) is a fine double, which can be well seen with a three-inch telescope.

Below this is Virgo, with one bright star, Spica, which is nominally of the first magnitude, though much fainter than Arcturus. The five stars which lie above and to the right of Spica also belong to the constellation. Below them are the groups of the Cup and the Crow, which are both on the back of the great Sea Serpent (Hydra). Due west, and pretty well up, is the Lion (Leo). The star α in this constellation is of the first magnitude, and bears the name of Regulus. The neighboring star γ is a fine telescopic double.

The Great Bear fills the upper part of the northwestern sky. Below it are Gemini and Auriga, both setting. Inside the curve of the dipper handle are the Hunting Dogs, with which the Herdsman is supposed to be pursuing the Great Bear. They have only one prominent star between them, which is worth a telescopic glimpse, as it is double. South of them lies the constellation of Berenice's Hair, a tangle of faint stars.

Below Virgo, on the left, is Libra, the Scales, which boasts only two bright stars. The southern one of the two is a wide double, interesting in a field glass. Farther southeast is Scorpio, the finest of the twelve zodiacal constellations, though so far south that we never see it to the best advantage. Its principal star, Antares, is one of the reddest in the sky, and is a very interesting telescopic object, both on account of its color and because it has a faint companion, of a vivid green hue, which intensifies the red by contrast.

β Scorpii is also a fine telescopic double, while μ can be seen double by the naked eye, when the air is clear enough to give us a good look at it.

Due south, below Virgo, we may see parts of the southern constellations of the Centaur and the Wolf. The former has two very bright stars, but they cannot be seen at all from points north of New Orleans.

In the southeast is the intricate mass of Ophiuchus, the Serpent Bearer, and Serpens, the serpent which he carries. Higher up, and almost due east, is the semi-circle of the Northern Crown, below which is Hercules. This is a large constellation containing several interesting telescopic objects. The star α is a fine double, the brighter star being red, and its companion blue. The principal component is variable in brightness, and has a superb banded spectrum, which may be easily seen by placing a prism in front of the eyepiece of the telescope. δ Herculis is also double, but the most interesting object in the constellation is the great star cluster which lies between the stars η and ζ, nearer the former. This is faintly visible to the naked eye, and easily in a field glass, appearing as a hazy spot of light, near which lie two small stars. Moderate telescopic power splits up the spot into hundreds of faint stars, while great telescopes show many thousands of them.

Below Hercules in the east is Aquila, the Eagle, just rising, and farther north are Cygnus, the Swan, with the Lyre above it, marked by the great white star Vega. Farther to the left are the circumpolar constellations—Draco and Ursa Minor above the Pole, and Cepheus and Cassiopeia below it.

THE PLANETS.

Mercury is morning star until the 9th, when he passes back of the sun and becomes an evening star. He is visible only during the last ten days of the month, when he may be seen in the evening twilight, as he sets more than an hour later than the sun.

Venus is evening star in Gemini and Cancer, and is very conspicuous, remaining in sight till about 9:30 P. M. Mars is also in Gemini, nearer the sun than Venus, and is hardly observable, as he sets at 8 P. M.

Jupiter is in conjunction with the sun on the 10th, and is invisible throughout the month.

Saturn is morning star in Aquarius, and rises near midnight on the 15th, so that he is observable in the early morning.

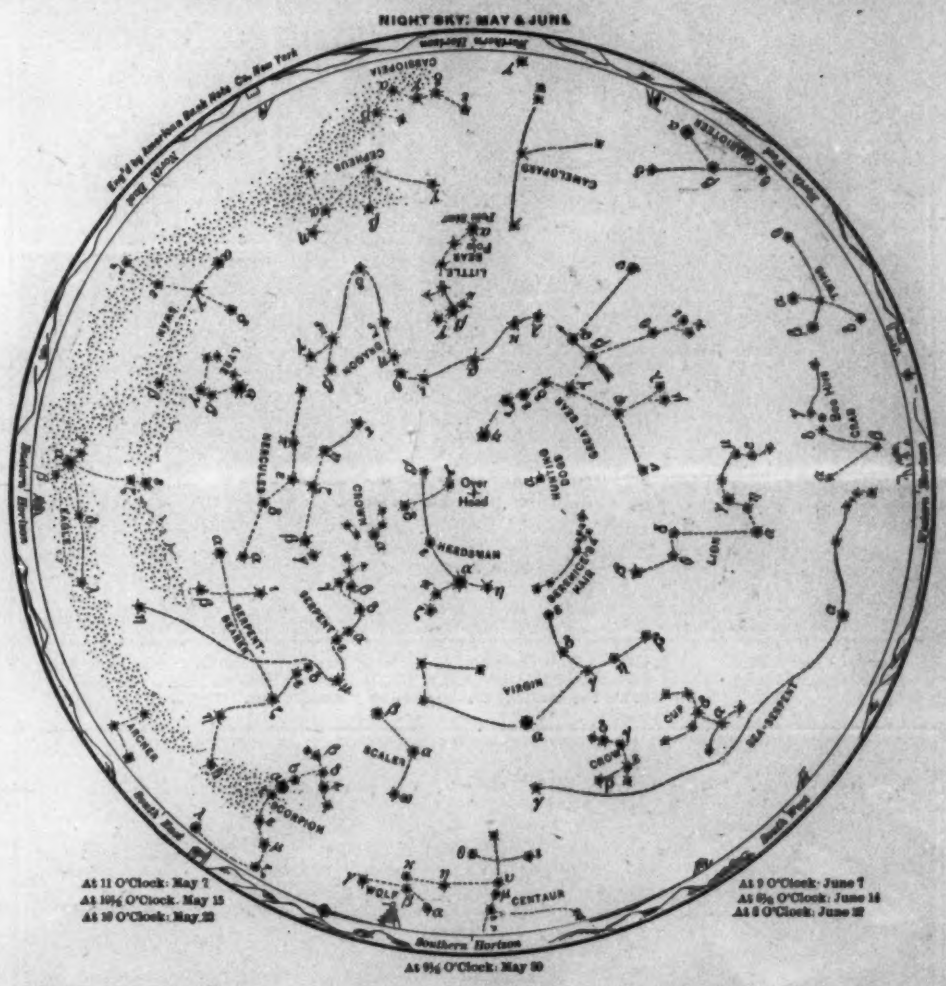
Uranus alone of all the planets is well placed for observation this month. He comes to opposition on the 28th, and is then in Sagittarius in R. A. 18h. 28m. 30s. and declination 23 deg. 36 min. south. He is moving slowly southwestward, at the rate of 10s. in R. A. and 7 sec. in declination per day.

Neptune is in Gemini, too near the sun to be observed.

THE MOON.

Full moon occurs at 4 P. M. on June 6, last quarter at 2 P. M. on the 13th, new moon at 6 P. M. on the 21st, and first quarter at 9 A. M. on the 29th. The moon is nearest us on the 6th, and farthest away on the 18th. She is in conjunction with Uranus on the 8th, Saturn on the 13th, Jupiter on the 21st, Mars and Neptune on the 22d, Mercury on the 23d, and Venus on the 24th. None of these conjunctions is close. At 3 P. M. on the 22d the sun reaches his greatest northern declination, and enters the sign of Cancer, and in the old almanac phrase, "summer commences."

Princeton, May 17, 1906.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

A NEW COMPOUND.

Continuing his researches upon the iodo-mercurates of the alkaline earth metals, M. A. Duboin, of Paris, after forming compounds with calcium and strontium, now succeeds in preparing the iodo-mercurate of barium and observing its properties. It has the form of a saturated solution, and this solution was previously obtained by Rohrbach, who found it to be remarkable as one of the densest bodies known, having a density of 3.56. Duboin determined the composition of this body, which contains barium, 12 parts, mercury 28.40 parts and iodine 52.16 parts per 100. This corresponds to the formula BaI_2, $1.33HgI_2$, $7.76H_2O$. It is a mixture of two iodides which are soluble in 96 per cent alcohol. The saturated solution has a density of 2.76 at 23.5 deg. C. When this liquid is saturated with bioxide of mercury at 70 deg. C., upon cooling it deposits oxide of mercury and also small crystals having the formula BaI_2, $5HgI_2$, $8H_2O$. These crystals resemble the corresponding salts of calcium and strontium, but they are more easily decomposed and become red after a time, even in sealed tubes. M. Duboin obtained another definite hydrate by keeping a liquid containing barium 11.67, mercury 22.41, iodine 49.59 at a temperature of —9 deg. This liquid has the formula BaI_2, $1.30HgI_2$, $10.41H_2O$. The hydrate that he thus obtains appears in the form of an agglomeration of large four-sided prismatic crystals. The formula for this body is $2BaI_2$, $3HgI_2$, $16H_2O$. Its density at 0 deg. C. is about 4.0. The crystals melt when the temperature rises. Another salt is obtained by the evaporation of a solution containing barium 13.95, mercury 19.16, iodine 50.22, or HgI_2, $1.07BaI_2$, $9.71H_2O$. When this liquid is evaporated under a bell-jar in presence of sulphuric acid, it deposits prismatic crystals which are very deliquescent. Their density at 0 deg. C. is about 4.06 and they have the formula $3BaI_2$, $5HgI_2$, $21H_2O$. Corresponding to this salt we have the iodo-mercurates of magnesium and manganese.

A UNIQUE VACUUM APPARATUS.

In a paper lately presented to the Académie des Sciences, Messrs. Georges Claude and R. J. Lévy describe an apparatus which is designed to utilize the property of carbon remarked by Dewar for producing a vacuum. This property consists in the strong absorption of gases by carbon when at the temperature of liquid air. The vacuum is made in several stages. A partial vacuum is obtained with an air-pump in the desired vessel and in one or more vessels containing carbon. The pump is then disconnected and one of the vessels plunged in liquid air. We thus form a new vacuum upon the partial vacuum already obtained in the carbon vessels and in the vessel in which we need the vacuum. The carbon vessel is then cut off and a second vessel is plunged in liquid air. It makes a still better vacuum on the main chamber and the remaining carbon chambers. We then cut it off and replace it by a third chamber, and so on. In practice, two carbon chambers are enough to obtain the highest vacua. The apparatus must be of simple design and arranged so that we may insert or cut out the successive chambers with the necessary rapidity and tightness which are indispensable for the very high degrees of vacuum obtained. The present apparatus is so combined that the operation of inserting or cutting out the chambers from the main vacuum chamber is carried out by mercury columns worked by piston plungers or by atmospheric pressure. The tops of the mercury columns are cooled by liquid air so as to eliminate the tension of the mercury vapor, which is a hindrance for the operations and for the perfection of the vacuum. As an example of the rapidity of absorption of the gases by the carbon we may mention that the experimenters, starting from an initial pressure of 2 millimeters of mercury, were able to arrive in 15 minutes to the extinction point for fine Crookes tubes of 80 cubic inches capacity which were exhausted at the same time.

LECTURE-ROOM BOOMERANG.

L. Pfaundler's paper on "Boomerang for the Lecture-room," which is printed in Akad. Wiss., gives the following information:

Small boomerangs of various shapes, and 6 to 10 centimeters long, are cut from aluminium foil 0.5 millimeter thick, and hammered convex on one side. These are placed on a small table so that the concave edge is to the front, and one end projects over the side of the table almost on a level with the top of a flat, vertical steel spring used for propelling the boomerang by hitting the projecting end. The boomerang shoots forward and upward for a distance of 5 to 6 meters, and then returns almost to the starting-point. The boomerang is gradually deformed by the repeated percussion of the spring.

THE BRIERLEY FOG-SIGNALING APPARATUS FOR RAILROADS.

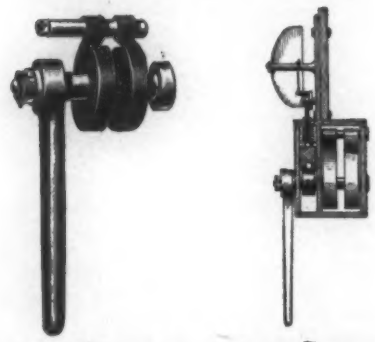
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Railroad engineers in Great Britain are following with great interest the experiments that are being carried out upon the Great Northern Railroad with a new signaling apparatus for operation in foggy weather. The system now used on this British railroad has been in service for the past three years, though its devices have been preserved a secret until their utility and certain action was conclusively demonstrated. The invention of Mr. Wynford Brierley, an experienced railroad engineer, who is consequently fully cognizant of the various problems that have to be surmounted in devising such an apparatus, the system is so designed that a failure would be sufficient to arouse the locomotive engineer's suspicions and cause him to come to a stop as soon as possible.

The Brierley apparatus is extremely simple, both in design and operation, and comprises a minimum of integral moving parts. The general character of the invention is plainly shown in the accompanying illustrations. Beside the track and close to the rails is a rocking arm carrying on either end a heavy head. The axis of this rocker is connected at one end with a lever, to which is attached the cable operating in communication with the semaphore with which the apparatus acts. The movement of the side lever, owing to its rigid fixation on the rocker, raises the one or the other of the two weighted ends to a horizontal position, according to the setting of the semaphore arm. When the latter is set to danger the weight nearest the track is horizontal — its normal position. The signalman in the cabin, when he lowers the semaphore arm, at the same time actuates the rocking arm of the apparatus, since a single cable operates both, and the weight at the opposite end is swung up to the horizontal, the other weight being naturally lowered out of the way.

On the engine is a small box from which extend two vertical triggers one behind the other as shown in the illustration. As the locomotive passes the apparatus on the track, one or other of these triggers according to the setting of the semaphore strikes the rocker, is forced backward, and at the same time rings a gong on the engine. This gong has an indicator the dial of which placed in the cab shows whether the road is clear or otherwise, and the engineer is able to act accordingly. When the trigger has passed over the rocker it returns instantly to its former position.

The mechanism on the engine is carried out upon novel and ingenious lines, especially that part which acts with the trigger and serves to return it to the vertical position after passing the rocker contact. Upon the horizontal shaft carrying the trigger is fixed a new type of coiled spring. There are two coils placed opposite one another, i.e., one has a left-hand coil and the other a right-hand coil. These are keyed to the axial shaft so as to become an integral part and



1. 2.

Fig. 1.—Double coiled spring fitted on lever stud showing trigger fitted on engine. Fig. 2.—Side section view of box showing general arrangement with gong actuated by oscillations of trigger after passing over contact, and reverse coiled spring.

The Brierley Fog-Signaling Apparatus.

The Large View Pictures the Rocker When the Semaphore is at Danger, Showing the Danger Trigger Passing Over and Making the Contact Which Rings the Bell in the Engine Cab. The Small View Shows the Contact for Signaling "Road Clear."

The Indicator and Bell in the Engine Cab Show the Position of the Semaphore Arm.

THE BRIERLEY FOG-SIGNALING APPARATUS FOR RAILROADS.

are of great strength and ease. In passing over the rocker contact, the trigger is forced backward until its angle is sufficient to ride over the obstacle. In so doing one spring is necessarily uncoiled, but simultaneously the other spring is coiled tighter. Consequently the moment the trigger has passed over the contact the trigger is brought sharply back to the normal vertical position, mainly by the action of the part of the spring which has been coiled tightly. This ingenious arrangement enables the apparatus to work equally well when the engine returns over the same road, the reverse action of the springs taking place. The value of this device is that the trigger is always brought back to the dead center, not violently, but slightly oscillating. If only a single coil spring were used, continual action of the trigger in one direction would tend to release the tension of the spring, so that the trigger would not always return to the dead center, and in a short time the spring would be so weakened that the trigger would not touch the contact at all. By using a reverse coil such as this, positive action under all and varying circumstances is insured, and the trigger is always brought to the same normal point. At the same time the mechanism constitutes an efficient cushion for absorbing the tremendous shock of the impact that results when the trigger strikes the contact when the train is traveling at express speed. The majority of such mechanical devices have failed at this point. The terrific force with which the moving part has been brought into contact with the stationary section breaks the apparatus. Three years' constant use upon the Great Northern Railroad, however, has shown that with the Brierley apparatus no such apprehensions need be entertained. The apparatus is placed on the section of the track where both north and south-bound trains pass, and even with trains traveling at 80 miles per hour no failure of action has yet been recorded, nor has the apparatus shown any signs of breaking under the enormous strains imposed upon it.

In the first type of apparatus the inventor relied upon electrical connections between the rocker and the trigger to ring the gong, but he has since simplified the invention, and arranged for this operation to be carried out mechanically. Not that the electrical system proved unreliable, but purely in the interests of the locomotive engineers. It was found that in the event of the electric bell failing through a broken or loosened connection or expended batteries the engineer was not possessed of sufficient electrical knowledge to locate the fault and remedy the defect. On the other hand, with a mechanical appliance, in the event of the gong not ringing he is able to more readily and easily ascertain the cause and unless there is a broken part, to set it right on the engine. The gong in this instance is wound up with a spring in the same manner as an alarm clock and is held thus by a catch. When the trigger makes contact, this catch is released by a cam and the bell set ringing, continuing until the driver either stops it, or it

has run down. Both types have been in use upon the railroad in Great Britain with equal success, though the mechanical form is considered the most suitable to ordinary working.

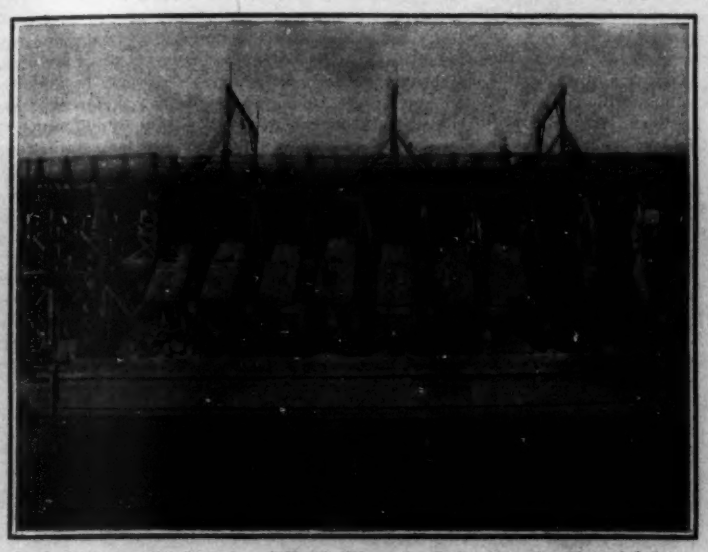
The gong can be carried on any part of the engine though the most preferable position is in the cab, where it is close beside the engineer, and the signals can be easily distinguished.

Each trigger and its accompanying spring constitute one unit, so that in the case of a locomotive carrying an installation to denote both "on" and "off" actions of the semaphore, two sets are required, but owing to the small space occupied by the mechanism they are carried in one box or casing. It will be observed that owing to the small number of parts and the comparative immunity from frictional action, the possibility of wear is considerably reduced. The triggers are held in sufficient tension by the spring to prevent them shaking with the oscillation set up by the train, and thus possibly giving a false alarm on the gong.

It will be observed that this apparatus does not supersede the present semaphore system, but rather supplements it, giving greater certainty and security, and enabling locomotive engineers to maintain high speeds in foggy or dirty weather with a greater degree of safety than is possible with the existing auxiliary signaling systems.

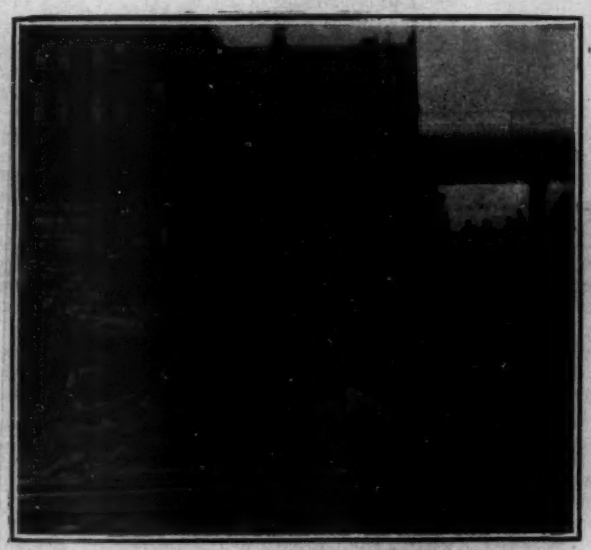
THE EXCAVATION FOR THE PENNSYLVANIA RAILROAD STATION, NEW YORK.

In our previous issue we gave illustrations of the noble building which will form the above-ground portion of the new terminal station of the Pennsylvania



Dock Built on 32d Street and North River for Unloading the Material from Cars to Scows.

Site of Station Power House, Showing Massive Concrete Retaining Wall 50 Feet Deep by 25 Feet Thick at Base, Which Incloses Entire Excavation.



The Cut Below Ninth Avenue Through Which the Excavated Material is Hauled to the North River.

Seventy-Ton Steam Shovel Working on Northerly Side of Excavation at 33d Street.

View of One-Half of the Excavation, Looking West, Showing the Trestle for Carrying Eighth Avenue During the Progress of the Work.

EXCAVATING FOR THE PENNSYLVANIA RAILROAD STATION, NEW YORK.

Railroad in this city. Great as are the proportions of the superstructure, with its great façades reaching for 780 feet in one direction and 430 feet in the other, it forms but the lesser portion of the station considered as a whole, with its tracks, switching yard, platforms, stairways, carriageways, baggage rooms, and other etcetera of a great terminal structure such as this. Moreover, this latter and larger half of the station, when the whole thing has been completed, will be entirely hidden from sight in a huge excavation lying entirely below the surface of the ground. It is to the vast preliminary work of preparation involved in digging out the underground portion of the terminal, that the present article is devoted.

If the reader will turn to the front page engraving, and bear in mind that it is a reproduction of a photograph which was taken from the tenth floor of a building lying to the northeast of the station site, he will get a clear idea of the form and size of the vast hole which is being dug in the heart of New York city. The excavation, which forms a parallelogram, includes two large city blocks. It is bounded on the north by Thirty-third Street, on the south by Thirty-first Street, on the west (the further end of the excavation as shown in the picture), by Ninth Avenue, and on the east, immediately in the foreground, by Seventh Avenue. Since the original dimensions were determined upon, however, two additions have been included—one on the southerly side, and the other on the easterly end. The southerly addition consists of a square plot for a power house measuring 90 by 160 feet. It will be noticed in the engraving, lying a little to the east of the long trestle that bisects the excavation at its center. The easterly addition, which measures 250 by 200 feet, will be seen in the immediate foreground. It extends from Thirty-second to Thirty-third Street, and it was purchased in order to afford accommodation for the convergence of the tracks where they leave the station to pass by two tunnels under Thirty-second and Thirty-third Streets, below Manhattan Island and the East River, to Long Island City. The total length of the excavation, including this last-named addition, is 2,050 feet, and its width is 500 feet. The total depth to which it must be finally excavated is 45 feet at the easterly end and 60 feet on the Ninth Avenue end, the average depth being about 50 feet. The total amount of material to be taken out is 2,000,000 yards, of which about one-half is rock.

As one looks at the long stretch of desolation presented by the station site to-day, it would be easy to suppose that either fire or a tornado had swept it bare of human habitation. Only three or four years ago the site was covered with over four hundred houses, stores, and other buildings, and was filled with some five or six thousand souls. The preliminary work of clearing away the buildings was not by any means the smallest task connected with the preparatory work for the new terminal station. The site once cleared, the work of excavation was of a very straightforward character and consisted of drilling, blasting, and steam shovel work. It was on July 1, 1904, that the cleared ground was ready for the New York Contracting Company, who had the job of excavation in hand, to commence operations.

Among the first portions of the work to be attacked was that of building the massive concrete retaining wall which runs entirely around the excavation. This is a big task in itself; for the wall is everywhere carried down to rock and for much of the distance extends to the full depth of the excavation which, as will be seen, averages 50 feet. The top of the wall is everywhere 5 feet in width, and it is built on a batter which brings the width in the deepest portions of the wall to an extreme base of 30 feet.

One of the problems which had to be met was that of maintaining the important thoroughfares which cross the station site. The principal of these is Eighth Avenue, and it was necessary, as the excavation proceeded, to build a massive trestle work with which to support not only the full width of the roadway, but the heavy sub-structure of the underground trolley electric road. Similar provision had to be made for Seventh Avenue, on that part of it which crosses the northeasterly addition to the excavation already referred to.

The problem of removing the 2,000,000 yards of excavation was a serious one in itself, and it will interest our readers to know that not a single cartload has been taken through the streets of New York city, the whole of it having been hauled by locomotives to the North River and dumped into scows to be disposed of on the Jersey shore. For handling the material a new wharf was built at the foot of Thirty-second Street and the North River. Along the wharf was constructed an elevated railroad which was extended through Thirty-second Street to about the middle of the block between Ninth and Tenth Avenues. At this point the tracks were carried down to, and under, Ninth Avenue, and into the station excavation. The whole of the work is covered with working tracks, which are shifted from time to time as the excavation proceeds, and all of these tracks converge to the deep cut below Ninth Avenue, of which we present an illustration. The material is loaded upon the cars either directly by steam shovels or derricks, and the loaded trains are hauled out to the North River dock, where the material is dumped into the chutes and discharged into the waiting scows. It is then towed down to Greenville on the Jersey shore of New York bay and used for filling in the huge freight yard, which the company is constructing at that point.

The force employed on the work has varied according to the conditions, nature of material, etc. The maximum force employed was about two thousand men, of which two-thirds were employed in day work, and the other third at night, and as much as 125,000 cubic yards a month has been taken out. At present the work is almost entirely rock excavation, and for this a total of about 700 men, including drillers, blasters, trackmen, etc., is engaged. Between sixty and seventy per cent of the work has been completed. As soon as the excavation has been carried down to grade, the steel columns will be erected and the steel and concrete floors put in place. When this work has been brought up to street level, the walls of the great station proper will begin to go up. It is the object of the company to so time the progress of the various sections of the work that no portion will have to wait upon any other, and the whole of this stupendous scheme of tunnels, terminal yards and passenger station may be brought to completion with the least loss of time and money through the enforced idleness of plants or delay of working forces.

Automobile Notes.

At the automobile carnival held last week at the Empire City track, some tests of technical interest to automobilists were held. Among the first day's events for touring cars were a flexibility test to show the range of speed on the high gear, and a braking test. In the former of these tests a circuit of the mile track was made at high speed, and then one-quarter mile was covered at the slowest possible pace that could be maintained on the high gear. The results were as follows: 50-horse-power Welch, mile in 1:21 2-5 (44.22 m. p. h.); ¼ mile in 2:34 (5.84 m. p. h.); speed variation, 39.38 m. p. h. 30-horse-power Marmon (4-cylinder air-cooled), mile in 1:37 4-5 (36.80 m. p. h.); ¼ mile in 2.17 1-5 (6.54 m. p. h.); speed variation, 30.26 m. p. h. 24-horse-power Clement Bayard, mile in 1:40 (36 m. p. h.); ¼ mile in 2:32 (5.92 m. p. h.); speed variation, 30.08 m. p. h. 24-horse-power Aerocar (4-cylinder air-cooled) mile in 2:07 2-5 (28.25 m. p. h.); ¼ mile in 3:27 4-5 (4.66 m. p. h.); speed variation, 23.59 m. p. h. 20-horse-power Northern (2-cylinder opposed) mile in 2:13 3-5 (26.87 m. p. h.); ¼ mile in 2:42 2-5 (5.84 m. p. h.); speed variation, 21.33 m. p. h. A 24-horse-power Autocar made a mile in 1:40 2-5 (35.85 m. p. h.), but the driver was disqualified for slipping his clutch when making the low-speed test. In making the brake tests the cars were obliged to travel at the rate of 40 m. p. h. for ⅛ of a mile before the brakes were applied. An Oldsmobile touring car stopped in 168 feet, and two other touring cars in 175 and 177 feet respectively. A Welch touring car ran an exhibition mile in 1:14, and a 12-horse-power Franklin touring car carrying four passengers beat a 24-horse-power Frayer-Miller touring car, winning a mile race in 1:45. Both these cars were air-cooled, and both have an enviable record for efficiency and economy.

Two hill-climbing tests of interest were held recently, one at Wilkes-Barre, Pa., on a hill christened "Giant's Despair," and another at Worcester, Mass., on what is known as "Dead Horse" Hill. The former hill is about 1⅛ miles in length and is full of "thank you ma'am's" and curves. The average grade is around 15 per cent and at places it reaches 27 per cent. The best time was 2 minutes 11 1-5 seconds. This was made by a 45-horse-power English Daimler touring car. A 50-horse-power 6-cylinder Stevens-Duryea touring car scored second in 2:27; and a 24-horse-power Pope-Toledo third in 2:56 4-5. A 22-horse-power double-opposed cylinder Buick car made the climb in 3:00 4-5; a 45-horse-power Pope-Toledo in 3:12, and a 35-horse-power Rambler in 3:18 1-5. The "Dead Horse" Hill course is one mile in length and straight. S. B. Stevens, on his 80-horse-power Darracq that ran in the last Vanderbilt cup race, covered this distance in 1 minute and 2 seconds, thus reducing by 7 seconds the record he made last year in his 90-horse-power Mercedes. A special 100-horse-power Stanley steamer, which is said to have made the climb in 50 seconds, was damaged and did not run. A 6-cylinder Stevens-Duryea was second in 1 minute 9 3-5 seconds, a 20-horse-power Stanley steamer third in 1:26, a 24-horse-power Pope-Hartford car fourth in 1:50, a 22-horse-power Buick fifth in 1:52, and a 16-horse-power Reo sixth in 1:58 1-5.

The Austrians use a stone blotting-pad that never wears out. A little scraping with a knife cleans it effectually.—Philadelphia Bulletin.

Correspondence.

Liquid Air and Powder Chamber Temperature.

To the Editor of the Scientific American:

In your issue of May 5 your editorial calls attention to the report of the National Coast Defense Board, in which it practically acknowledges defeat so far as greater velocity is to be obtained by large-caliber guns.

I have not noticed a report of liquid air being used for the purpose of keeping down the temperature of the gases; and while I have not had the opportunity of making tests in this line, I would like to see some experiments made to see if liquid air can be successfully made use of to this end, by placing a small quantity, say 25 or 30 cubic inches, at the back of the shell, or use a double shell, so there will be a wall of liquid air all around the explosive, the intense heat of which will instantly expand the liquid air eight hundred times, thereby reducing the temperature sufficiently to preserve the gun from erosion. L. C. M.

Houston, Texas, May 17, 1906.

Earthquakes and Steel Construction.

To the Editor of the Scientific American:

In your copy of April 28 I read the article about "Earthquake-Proof Construction" in which you recommend concrete steel for the reconstruction of San Francisco. Why not use steel and iron only, the same as on steamboats and other strong sea-going vessels? After a good, strong steel framework put in iron or steel panels between and also iron or steel floors and partitions; let such walls or panels and partitions be very light, perhaps not much thicker than sheet iron, which also could be made very ornamental and artistic, the same as steel ceilings are made now. The floors, naturally, should be made stronger. Such a building should be strong and elastic enough to withstand any earthquake; besides, it would be fireproof, and on account of the mild climate in California it would be comfortable to live in. Another thing which you advocate is a water tank on top of each building, at least in the business part of the city. Now, why not build large water tanks right under the streets in front of every large building?—because, if put on top of a building, they are apt to tumble down in case of an earthquake. If such tanks were put in the center of the streets with a manhole on the top, the firemen could very easily let down a hose and suck the water up with their fire engine; besides, such tanks would be most available at all times.

If my idea is wrong, kindly let me know where and why, because I would very much like to have your opinion about this. Please give me an answer through the Scientific American. A. Mayn.

Amsterdam, N. Y., April 28, 1906.

[It would be practicable to erect all-steel buildings; but concrete-steel would be cheaper and equally earthquake and fireproof. Water tanks under the streets would be too costly to be practicable.—Ed.]

The Metric System.

To the Editor of the Scientific American:

The Scientific American has committed itself as in favor of the introduction of the metric system of weights and measures, and this supposedly means the metric system exactly as it is used in France and other countries and without any modifications whatever. Scientists, as a rule, take this position with the exception of those whose work is in connection with the manufacturing end of a business; manufacturers, whom the change would affect most, are almost all against it; the most eloquent argument in this respect is the array of names and opinions recently collected by Mr. Halsey.

The metric system is consistent and excellent in many respects, and, had it been introduced into English-speaking countries at the time when it was introduced in France, it would have stayed and possibly have flourished. At the present time, however, a law such as that proposed by Mr. Littauer could not be enforced; manufacturers who will not or cannot face the expense, and buyers who are satisfied with the present measures, would stand united, and government interference would be impossible. There is no demand for metric measures from the buyers of mechanical or mechanically made goods. If the government insisted on purchasing metrically, the number of bidders would decline, prices go up, and deliveries be slow.

The division into halves and quarters is the most natural, and I will ask you to take a look with me at certain details of the domestic life of the country which has had the metric system in use for the longest period of time.

Come with me to a French market. The first stall is the dairyman's. "How much is this butter?" you ask. "Thirty-eight sous a pound," is the answer; not "Three francs sixty a kilo." If you ask the vender to give you 125 grammes, he will take you for a foreigner, and will bill it as "un quart." Eggs will be thirty sous a dozen; nothing is sold by tens. Potatoes you buy by the bushel (*boisseau*), which is not metric, and

a *barrique* of wine holds 227 liters. You buy cloth by the meter, half-meter, and quarter-meter, and the salesman would lift his eyebrows if you asked for 60 or 70 centimeters of ribbon.

The centime is to the American cent as the millimeter is to the inch. It is too small, and everything therefore goes by five centimes, commonly known as a *sou*. The centime does not harmonize with the coins in use.

The millimeter for engineering purposes is very inconvenient. I speak from experience. The natural divisions of the inch into halves, quarters, and eighths do not give us over three decimals; and if into sixteenths—which is a better working size than the millimeter and not very much longer—four decimals, the last being in all cases a 5. With the French system an 18-inch lathe becomes a 225-millimeter H.D.P. lathe; and to form a mental image of the swing a man is compelled to think of a height of 2¼ decimeters from the ways to the center. For very fine measurements the one-thousandth of an inch is in every way as satisfactory as the one-hundredth of a millimeter—I have found it more so—and all natural divisions down to thirty-seconds can be read in thousandths and halves or quarters of thousandths. We are, therefore, getting the benefits of both the natural and decimal divisions, and there seems to be no reason whatever for adopting a different standard unit which is as arbitrary as ours, when we, Anglo-Saxons, hold the controlling interest in the markets of the world.

When it comes to the laboratory, matters are very different, and I will agree that the interrelations of the gramme, the cubic centimeter, and the centiliter are of the greatest utility. For analysis, the milligramme and the centiliter are vastly superior to the English measures; but the quantitative work done in the laboratory in no way influences the weights and measures of the works to which these laboratories are attached.

Let us have the metric system by all means for laboratory work, but not for the vastly greater amount of work which does not require delicate instruments and intricate calculations. We cannot use a microscope on the stars or a telescope on bacteria, nor can we use a reading glass for either. A system which will suit both science and industry has not yet been devised.

If you will expend your spare energy on introducing the centigrade thermometer, killing off antiquated wire gages and the like, you will be working with a better chance of success than by backing a change which is not warranted by necessity, and not demanded by the majority of those who would be affected by the change. It is even opposed by the manufacturers of gages, whom you might expect to find in the forefront of its champions.

ALFRED SANG.

Pittsburg, Pa., April 14, 1906.

Wood and Concrete Construction.

To the Editor of the SCIENTIFIC AMERICAN:

When your expert on concrete construction next discusses his specialty, please let him take up the practicability of using concrete or armored concrete in wooden framework. In brief, could it be used in walls between laths and weather boarding? If so used, would it do away with the necessity of rough-boarding? Could it do away with the laths, too? Would the steel bands, screwed or nailed to and between the joists, hold the joists and concrete sufficiently tight to prevent the joists from falling away as they dried out? If practical in walls, would it also do for use in floors, and if so, would it be of enough advantage from a fireproof and noise-deadening standpoint to warrant its use?

All these questions are asked by a decidedly amateurish delver into the mysteries of how to build the best home at the least expense consistent with good work.

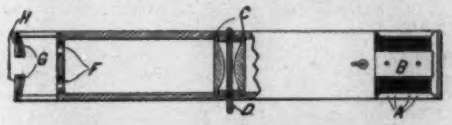
MORTON WATKINS.

No. 223 West 106th Street, New York city.

[It would hardly seem desirable to combine concrete construction with wooden framework, notwithstanding that there are apparently no technical difficulties to prevent this. The impracticability of the construction would lie in the fact that while the concrete would, of course, be fireproof and moisture-proof, the woodwork could not be considered to answer these requirements, and, therefore, the resulting structure would correspondingly be only semi-fireproof or semi-impervious to moisture. The woodwork would probably pull away from the concrete as the latter dried out, for not only would the concrete contract, but the wood itself would shrink when the moisture which it had absorbed from the water in the cement had evaporated. This shrinkage both of the wood and of the concrete would probably not be sufficient to cause much damage, and the steel bonds imbedded in the concrete secured to the wood would doubtless hold the structure rigid. If such a construction were used, the builder would probably be able to dispense with rough-boarding, and the resulting partitions and floors would undoubtedly be more nearly soundproof than an ordinary frame construction. It would be far better to build directly of concrete, and probably the expense would be no greater in that case.—ED.]

APPARATUS FOR VIEWING DIFFRACTION COLOR PHOTOGRAPHS.

Some seven years ago Prof. R. N. Woods, now of Johns Hopkins University, Baltimore, described his new diffraction process of color photography, which was a novelty on account of its simplicity. The process is fully described in the SCIENTIFIC AMERICAN SUPPLEMENT No. 1227. Until recently no satisfactory instrument was invented for viewing the diffraction color photographs. The improvements in this line



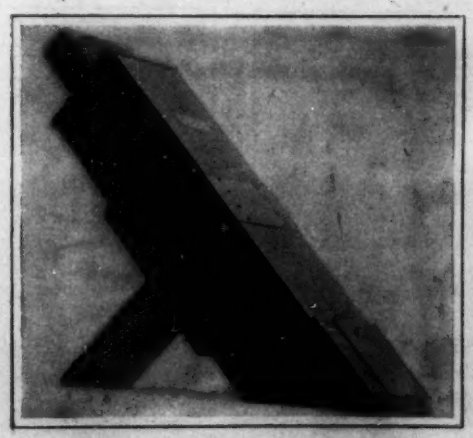
INTERIOR OF THE DIFFRACTION CHROMOSCOPE.

have been made by Mr. Herbert Ives, B.Sc., and Mr. Fred. E. Ives, the inventor of the kromoscop, which greatly simplify the necessary apparatus and considerably reduce its cost. It is called a multiple-slit diffraction chromoscope.

The diffraction color photograph is preferably made on a small plate of glass about the size of a lantern slide for convenience of handling and viewing, although there is no reason why it may not be made larger. The diffraction photograph is a mosaic com-

VIEWING END OF THE DIFFRACTION CHROMOSCOPE.

posite image in regularly spaced microscopic indented lines of three photographic color records, representing the primary colors, red, green, and blue. The red element of the composite color record is made up of 2,406 lines to the inch, the green of 3,000 lines, and the blue of 3,606 lines. The method of manufacture is to print on a bichromatized film respectively one after the other and over each from negatives originally taken in the camera, through screens of red, green, and blue with gratings of lines as above mentioned;



THE IVES DIFFRACTION CHROMOSCOPE.

then developing the composite print in the usual way by hot water. From this plate duplicate impressions can be made by a special method. This duplicate, exactly a counterpart of the original, is bound between two plates of glass, and becomes the medium for producing the colors when viewed in the instrument. If the glass plate is held up to the light behind a sheet of white paper, it appears to be perfectly clear. When put in the instrument the light is dispersed evenly as it passes through the plate, and the colors are reproduced exactly as in nature.

The diffraction chromoscope is essentially a dark box with a slit at each end and lenses in the middle to pick up light from one slit and concentrate it upon the eye at the other slit. If both slits are placed in the axis of the box, and the photograph inserted, it shows no color whatever; but if either slit is displaced in a direction parallel to itself, the direct light is no longer brought to the eye, but at the correct position light bent and dispersed by the microscopic diffraction lines takes its place, and owing to their disposition and distribution the colors seen correspond exactly to the colors of the object photographed. Mr. Ives's diffraction chromoscope has four primary slits instead of one, utilizing first and second order spectra on both sides of the axis, and thereby securing sufficient illumination to permit of use in diffused daylight, which would otherwise be impossible.

In the diagram *A* represents the four slits, with a central plate, *B*. Directly under *B* is a mirror which reflects the light upward through the plano-convex lenses, *C*, about three inches in diameter, also through the photograph, *D*, and openings, *F*, through the eye lenses, *G*, cemented to the inner side of the glass slits, *H*.

The hook shown just above the plate *B* is to hold an incandescent light for artificial illumination.

The upper illustration shows clearly the viewing slits, the hinged brace for supporting the box, and on the side is a pivoted plate which can be swung around by removing the screw eyes, for the purpose of taking out the lenses for cleaning.

The lower illustration shows the slot opening on the side of the box for inserting the picture, the latch for locking the supporting brace, the plate and slits at the bottom, and the hook for locking the hinged mirror. By releasing the hook the mirror can be folded back on the box to be cleaned.

By using four primary slits in the bottom, a greater quantity of light is admitted, giving correspondingly a more brilliant illumination of the image than would be the case if but one slit was used.

Altogether, it is about the simplest natural color reproducing apparatus yet devised, not liable to get out of order. It is calculated to excite wonder and astonishment to those unfamiliar with the optical principles involved, for from an apparently invisible picture without color is reproduced one perfect in color. Mr. Ives has devised special cameras for producing the original negatives.

The Current Supplement.

The current SUPPLEMENT, No. 1587, has for its first-page article two views of the Brunnen-Morschach Alpine railway. "Some Practical Experiences with Steam Turbines" is by C. E. Stanton, and will be welcomed by all engineers. "Reservoir, Fountain, and Stylographic Pens" is a continuation of a valuable series. "Cement Materials and Industry of the United States" is by Edwin C. Eckel. "Electricity in the Home" is a finely illustrated article showing novel electrical contrivances. "Surveying on the Farm" is a valuable article. The Science, Electrical, and Engineering Notes will be found in their accustomed places.

Lower Foreign Postal Rates.

The Congress of the International Postal Union, which has been in session at Rome, practically completed its labors on May 22. The Congress has inaugurated several changes which directly affect the public, and the most important of these is the reduction of the rates of foreign postage for heavy letters. Not only has the unit of weight been raised from 15 to 20 grammes, but the postage has been decreased as well from 5 cents to 3 cents for each unit of weight in addition to that constituting the first charge.

As the Anglo-Saxon countries do not use the decimal system, these changes will be even more favorable to them than to those which use the system, for the British delegates succeeded in obtaining the ounce as the unit equivalent to 20 grammes, while as a matter of fact an ounce is in excess of 28 grammes. Unfortunately, the British and Japanese proposals for a reduction of the initial rate to 4 cents failed. Universal penny postage advocated by New Zealand was not considered practicable. Other important changes were instituted relative to the internationalization of the right to use the left-hand portion of the address side of picture post cards for writing other than the address, and the use of post cards having an attached reply coupon.

The manufacture of cement in the United States continues to make remarkable progress. Whereas in 1890 there were sixteen factories, producing annually 335,000 barrels of Portland cement, there were, in 1905, eighty-two plants, with an estimated annual output of 31,000,000 barrels. The manufacture has increased about a hundredfold in sixteen years, for in 1889 the total production was 300,000 barrels. Since the great extension of the use of this material, the amount of natural cement produced in America has rapidly declined.

WATER STERILIZATION.

BY DR. ALFRED GRADENWITZ.

Whereas chemical analysis alone was formerly relied upon to determine the degree of purity of water, a still more important investigation has been found of late years in bacterioscopic examination. In fact it has been shown that water may contain all kinds of bacteria through which infectious diseases are produced

Fig. 3.—Stationary Sterilizer Having a Capacity of 66 Gallons per Hour.

and spread. Recent experiments have proven beyond doubt that bacteria liable to injure the health of man are rapidly killed at a temperature of 221 to 230 deg. F., and, provided each drop of the water be submitted to such a temperature, even if for but a short interval of time, the water in question may be safely said to be sterile. It will not, however, be fit for use as drinking water, before being cooled down to a temperature suitable for its consumption, while the well-known vapid after-taste should be eliminated by mixing the water with air free from bacteria in order to restore to it the character of fresh water. Filtration will, moreover, be likewise necessary in many cases.

A suitable type of sterilizing apparatus where these various operations are carried out effectively has been patented by Messrs. Rietschel & Henneberg, of Berlin, and is described herewith and illustrated in the accompanying engravings.

Each of these outfits consists essentially of a boiler, where the water is heated; a cooler, where it is brought down to a suitable temperature, and a filter for cleaning and aerating it. In the boiler, which may be heated by any kind of fuel or by steam from another source, the temperature of the feed water is raised to a temperature of 221 to 230 deg. F., corresponding to a pressure of the steam of 0.3 to 0.5 atmosphere. Now, as in any other boiler, owing to the difference in the specific weights of the cold and warm waters, there is a more or less rapid circulation, and any shock throwing the feed water from the filter into the boiler will produce a cold current up to the boiling surface, the cold and warm waters not being susceptible of immediate mixture owing to their difference in density. If in a similar boiler water be drawn from the warmest place, there will always be the risk of obtaining water that has just come to the surface under the action of the currents referred to, before having undergone the amount of heating required to kill the bacteria.

In the Rietschel & Henneberg boiler, however, no drop of water leaves the boiler before having reached the proper temperature and without having been maintained at the same during a certain period. This result is obtained by arranging within the water compartment a coil which causes the steam pressure above the water surface to act upon the water discharged from the warmest part of the boiler. The latter requires some time to traverse the coil, and thus the boiling water that surrounds the latter will prevent any loss of heat, while in some cases it will even supply to the water further heat. As the coil carries a thermometer immersed in the discharged water, a means is provided readily to control the operation.

A special feature is a valve by means of which steam may be conveyed from the sterilizing boiler through all the conduits and apparatus, that is to say, throughout the path of sterilization, and which allows the whole of the conduits to become sterilized before the plant is started. In the case of the intermittent operation of the plant a special arrangement is provided in the shape of a double-seated diaphragm valve to replace the serpentine above described.

The second part of a sterilizing plant is the cooler. This permits of a calorific exchange between the highly heated sterilized water issuing from the boiler and the feed water used for cooling the latter, thus raising the feed water to a temperature as high as possible. By means of the return current principle, the sterilized water can be cooled to a temperature which lies only 5 to 9 deg. F. above the initial temperature of the feed water, while the feed water supplied to the boiler is preheated at the same time to the boiling point. This recovery of heat is unquestionably an advantageous feature, and the amount of heat to be produced in the boiler corresponds to the difference only between the admission and discharge temperatures of the boiler, i. e., to but a few degrees. The third part of the plant is the filter, where the sterilized and cooled water which still contains impurities of an earthy and vegetable nature, as well as iron precipitates and the like, is purified. The water which has acquired a disagreeable

Fig. 4.—Steam-Operated Water-Sterilizer Producing 26.4 Gallons of Sterilized Water per Hour.

aftertaste due to the boiling process is finally saturated with air in the filter and is passed over substances which destroy the vapid boiling taste and restore to it the character of real potable water. After entering the filter from a kind of rose, the sterilized water falls in the form of a spray on the dense filtering material placed underneath, thus coming into intimate contact with the sterilized air fed through a special filter. A strong addition of bone charcoal has been found to be the best means of destroying any taste in the water due to boiling.

A perfectly sterilized water can, it is true, be also obtained by distillation, but the above-discussed sterilizing process is much less costly, while it is just as efficient. In fact, one liter at 0 deg. requires for distillation about 640 calories, while 110 calories, that is to say, about one-sixth as much, are necessitated for sterilizing the same amount. Furthermore, about 90 per cent of this heat is recovered by the cooling process in preheating the feed water. Wherever the freeing from noxious germs (bacteria) is the most important point, sterilization will moreover prove more satisfactory, while distillation should be resorted to only for chemical purposes, where soluble salts, for instance, are also to be eliminated.

By the courtesy of Mr. R. A. Hartmann, of Berlin, who is the constructor of the apparatus, we are enabled to illustrate and briefly describe some of the most interesting special types showing the large variety of applications of which the apparatus is susceptible.

For use in time of war, transportable sterilizers have been constructed having a capacity of 500 liters of pure water per hour. Figs. 1 and 2. This capacity may be said to correspond to the re-

Fig. 7.—The Sterilizing Outfit Packed on a Mule.

Fig. 6.—Portable Sterilizer for Producing 26.4 Gallons per Hour.

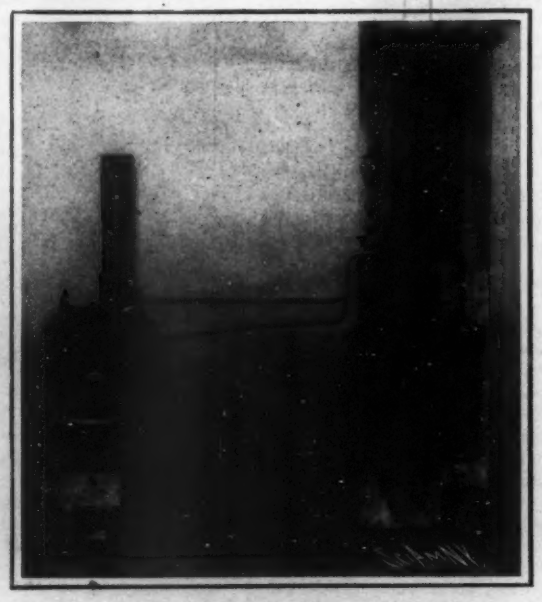


Fig. 5.—Direct-Heated Sterilizer of 26.4 Gallons per Hour Capacity.

VARIOUS FORMS OF STATIONARY AND PORTABLE WATER STERILIZING APPARATUS.

quirements of one battalion. Two pumps, *P* and *P'*, draw the water into the mechanism through a suction nozzle, where any larger impurities are retained. By the convenient arrangement of two three-way cocks, *D, D*, the water entering can be conducted at will either into the boiler, there to be sterilized, or into the cooler, *C*. In normal operation, the pump, *P*, is used as boiler feed pump while *P'* is connected to the cooler. After entering through the feed pump, *P*, the cold feed water is raised rapidly to the proper temperature in the boiler and should be left there for about 10 to 15 minutes at a steam pressure of about 0.5 atmosphere. In the type of sterilizer represented in Figs. 1 and 2, which is of 500 liters output, the cooling water is fully utilized for feeding so as to involve no consumption of the same, a fact which obviously reduces greatly the cost of operation.

Though these sterilizers are intended primarily for use in connection with transportable plants, stationary installations are also constructed on the same principle. The stationary sterilizer represented in Fig. 3 has a capacity of 66 gallons per hour. A special feature of this type of apparatus is an electrically operated minimum thermometer located at the outlet of the coil. As soon as this thermometer registers below a given temperature, it will ring an alarm, thus informing the operator of the fact that the outlet water has fallen below the admissible minimum temperature. Similar plants of about 26 gallons output will be found suitable for the use of single houses or special sections in hospitals (see Fig. 4). A like apparatus, but for intermittent operation, is shown in Fig. 6. The apparatus will prove especially useful in connection with scientific and military expeditions, and a special outfit having a total weight of about 100 pounds has been constructed for such purposes. This can be either loaded on pack animals or can be carried in sections by two men (see Figs. 7 and 8). It may be mentioned that similar types of apparatus have been used to advantage in connection with the present military operations of the German troops in Southwestern Africa.

Fig. 8.—Portable Sterilizer Carried by Two Men.

Fig. 9.—Portable Sterilizer in Operation.

Irrigation in California.

Southern California leads the United States in diversity of methods of application, in scientific distribution and conservation, and in the extensive character and boldness of design of its irrigation works. Surface water, drainage water, seepage water, water from artesian wells, and from tunnels penetrating the mountains, and water impounded in large and costly reservoirs are alike utilized.

The irrigation systems of this part of the State are known all over the world, and have created a prosperous commonwealth in a region which would be a scene of utter desolation without them. The concrete examples of intensive farming with this climate and soil are such charming settlements as Riverside and Redlands, whose praises are sung everywhere. North of this section, and from an irrigation standpoint considered almost equally important, is the San Joaquin Valley. The San Joaquin River supplies 54 per cent of all the lands irrigated in this State, but only 30 per cent of the total number of farms and 8 per cent of the irrigation canals. These percentages indicate an entirely different type of farm from that which prevails in the southern region. In the latter the high-priced products produced, the heavy cost for water, and the necessity for careful and intensive farming have resulted in the smallest farm units in the West. The farm units in the San Joaquin Valley average more than 100 acres, while in the southern region they are less than 23. In the valley of the San Joaquin the methods of irrigation have been more nearly typical of those of other sections of the West. Water has been wasted, extensive areas of the valley have been damaged and must be drained to be made productive.

The tendency in the northern valley has been to cultivate general crops and to retain large areas for grazing, with the result that farming has not been so profitable as in sections where special crops are grown and all of the land cultivated. A recent investigation of the agricultural, climatic, soil, and power possibilities within and about the borders of this valley furnishes an important contribution to our knowledge of this section of California. This investigation has been carried on by the Division of Hydrology in the United States Reclamation Service, and extended from the southern end of the valley northward to the southern line of Madera County, covering approximately 7,880 square miles. Within this area it was found that the amount of underground water which lies near the surface, and is available for irrigation purposes, is enormous, and that its value is but little realized. Thus far only about 250 second-feet have been developed for municipal and agricultural purposes, which is a very small percentage of the total amount available. The valley is filled largely with granitic sands and gravels, and there are large surface deposits of silt and rich alluvial mold. This filling is saturated with the flood waters and the returning irrigation waters, which thus constitute an extensive underground reservoir which, properly developed, will serve to reclaim thousands of acres now barren or in stock ranges. The situation of this section in relation to adjacent non-productive portions of the West is such that it will inevitably become of increasing importance from an agricultural point of view. It is the conviction of the board of engineers which considered the data obtained by this investigation, that the greatest increase in the agricultural development of this valley will come from a proper utilization of this available water power. This was doubtless impressed upon them in some measure by the fact that in Southern California underground waters to-day supply more than half as many farms as are irrigated by all of the ditches of the San Joaquin River. In order to develop these underground waters, cheap power is necessary. The cheapest power available is that which is developed by the transformation of the water power of the Sierras into electrical energy, and its distribution in this form to points where it is needed. Of the numerous streams that flow from the Sierras to the valley, upon which electrical power can be developed, the only one that remains available for the Reclamation Service is the Tuolumne. Upon all of the others the important reservoir sites and rights of way are in the hands of private or corporate interests. In fact, a monopoly of power now exists, fostered and encouraged by the unwise policy of giving away without restriction or reservation these most valuable power sites. The people of the valley and of the whole State in general are now awakening to the fact that they have a direct interest in the preservation of these reservoir sites, in order that they may be available for future use by the government in irrigation development. They recognize that these valuable power sites should no longer be permitted to pass from the government into the hands of monopolists, who exact from the people undue profits from a few which they develop, and prevent the development of the rest; that these public utilities should be so guarded that the benefits arising from their development shall accrue to all, and not to the few. These conditions do not alone prevail in California; they exist in every mountain State. There is a great demand from the people that these valuable power possibilities should be retained for the use of the whole people until further development can be undertaken by communities or by the government.

The San Joaquin Valley offers one of the most important situations for the development of large water power at small expense found anywhere in the United States, and there have been extensive developments of this power on many of the more important streams. A peculiar condition arises from the fact that the lands of the valley are all private lands, many of them in large holdings; while the Sierra Nevada Mountains, which border the valley on the east, are practically all covered by Forest Reserve withdrawals and are largely public lands. The normal flow of all the rivers of the valley (the summer flow in this valley is greater than the winter flow) is now diverted for irrigation purposes. Aside from the increase which may come from more careful and systematic irrigation and cultivation, agriculture cannot be extended materially from the surface water supply. It is the undivided opinion of the engineers that the greatest increase of irrigation in the future will result from pumping rather than from impounding and regulation of flood waters.

So much impressed were they with the possibilities of this section, that they recommended that the investigation of the underground waters be completed, and that all reservoir sites within the Tuolumne basin, together with the necessary lands for rights of way for power conduits, be withdrawn from entry pending further investigation, and held for future use by the United States in the development of irrigation in the valley. They also recommended that if any of these rights of way or reservoir sites are released for necessary public use, it shall only be upon the condition that the

Fig. 1.—Portable Military Sterilizer. Capacity, 500 Liters per Hour.

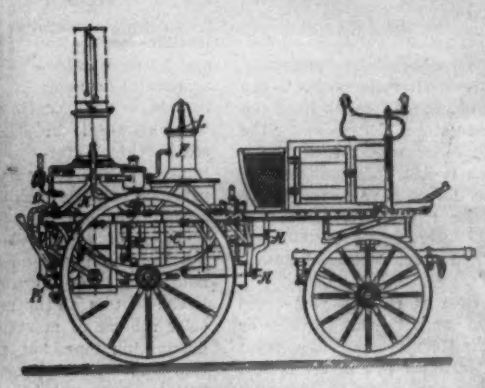


Fig. 2.—Diagrammatic View of the Portable Military Apparatus.

VARIOUS FORMS OF STATIONARY AND PORTABLE WATER-STERILIZING APPARATUS.

United States may at any time take control of them by paying a fair price for the works alone, exclusive of the value of the location and water rights.

THROUGH A WINDOW OF THE SEA.

BY CHARLES FREDERICK HOLDER.

Along the great blue current of Japan that sweeps down the California coast, a climatic peacemaker, is strung a chain of gemlike islands. They are the summits of offshore Sierras, a coast range of California that has been partly overwhelmed by the sea, their tops now crested with verdure, and washed by the warm stream that modifies the entire coast. These islands, from twenty to sixty miles offshore, rise from very deep water without premonitory shoals or reefs,

The California Sheepshead.

and could we see them divested of the ocean they would appear like gigantic needles rising from the bottom. All have a peculiar beard, or protecting growth of weed, that constitutes a perfect laminarian forest about them, a giant seaweed growing in water sixty or more feet in depth, and forming a natural wave brake and a home for countless marine animals.

The vines are sometimes one hundred feet in length, vast cables, with broad crimpled leaves of a dark olive hue, which assume graceful shapes in the tide; and when one peers down into the turquoise water the scene is often a revelation. A new world is opened up, and the real beauties of oceanic or submarine scenery are appreciated. The great leaves are carried by the fitful currents that sweep these islands in every direction. Sometimes they are extended at full length and appear like a horde of green snakes; again they lie upon the surface, listless and drooping, taking myriads of shapes, and forming nooks and corners of great beauty.

So attractive are these kelpian forests, so fascinating, that what is known as the water glass has been elaborated into a glass-bottomed boat, which virtually has several large plate glass windows through which the passengers may look down into the kelp forests and view a panorama of the sea. These glass-bottomed boats range in size from rowboats in which a dozen people can be taken out, to side-wheel steamers, so arranged that they can float over the forest and view its wonders up and down the coast. One of these odd craft is so large that several hundred passengers can look down through its windows at one time.

Avalon is the headquarters for the glass-bottom-boat men, and their vessels cruise up and down the smooth north coast of Santa Catalina, that appears to be admirably adapted for the purpose, being in the lee and abounding in coves and bays—the mouths of cañons that nearly always are smooth and often like disks of steel. There are no hackmen at Avalon; it is a sort of mountain Venice, and carriages are at a discount. The captains of the glass-bottom boats replace the hackmen of the mainland and cry the merits of their strange craft, each of whom claims to the knowledge of some especially attractive sea meadow or glade over which he will take one.

What the voyager in the glass-bottom boat generally sees, and with the same surroundings, is shown in the accompanying illustrations of animals, taken from the kelp forests of Avalon and adjoining waters under the direction of the writer; in other words, each photograph shows the animal as it has been seen by the writer; and as the various forms have never before been photographed and some have never figured in books, they have an especial interest as a contribution to popular entertainment and exact zoological knowledge.

When the glass-bottom boat starts the passengers are at first regaled with the sandy beach. In three or four feet of water the wave lines are seen, the effect of sea on soft sand, the delicate shading of the bottom in grays innumerable. Now the collarlike egg of a univalve, or the sharp eye of a sole or halibut protruding from the sand. A school of smelt darts by, pursued by bass, and as the water deepens flocks of surf fish, gleaming like silver, appear; then a cormorant dashing after them, or perchance a sea lion browsing on the bottom, or in pursuit of prey. Suddenly the light grows dimmer and almost without warning the craft is in the depth of the kelpian forest. The fitness of the term "hanging gardens" is apparent, as the great leaves appear to rise near the surface, then droop over, forming arches, parterres, and loops, conveying the impression of being suspended at the surface. The color is a deep olive grading to yellow, the leaves a foot or two wide and very long, their edges crimpled. Each is seen to be covered with a lacelike network of great delicacy. Fragile plumes wave to and fro, telling of worms or minute Sertularians. Here the tracery is white, the deposit of some animal, gleaming like frosted silver, while others are of lavender hues. The vagrant beams of light that strike the surface bring out the tints and shades in strong relief. Through a loop of kelp is seen the blue of the deep water, and poised in it, an angel fish of vivid orange tint that persists in taking black through the camera. A school of these fishes swim into view, turning their gorgeous shapes upward and eyeing the strange window in which are mirrored many faces. With them are small fishes of brilliant blue iridescence suggesting the strange vagaries of nature, as the very young angel fishes are almost entirely blue, and called by the skipper electric fishes; but as they grow the blue merges into yellow and the adult blossoms out in its perfect coat of gold or orange.

On the leaves are singular crabs, red and olive, with square shells, and deeper, in the crevices of the moss-covered rocks, are gigantic spider crabs, mimicking the rocks in shape and hue. The nature of the forest is ever changing. Now great pompons of a dark weed appear, a tint born of the deep sea. It waves gracefully as the slight swell comes in, and as it turns aside, displays the very giant of the starfishes, a huge creature garbed in red with white spikes or tubercles scattered over it, making it a most conspicuous object among the greens. In the crevices are smaller stars; some a vivid red, others dark, with arms like snakes.

Among the weeds long serrated waving spines are seen—the antennæ of the California crawfish, or spiny lobster, which takes the place of the lobster here. Its red, yellow, and brown tints so harmonize with the weed that it is almost impossible for the novice to see it, although he has the word of the skipper that the spines are waving beneath his eyes. At night the crawfish comes out and wanders abroad in these pastures of the sea, and even now he can be seen as the kelp is brushed aside, trim, debonair, ready to dart backward at the slightest warning.

The bottom changes to a finer moss or weed—a deep velvet green, with here and there iridescent tints, and in it lie great sluglike sea cucumbers in brick-red shades. Presto! the captain of the glass-bottom boat transports his passengers to a deep glen in which lacelike weeds rise and poise, forming a natural canopy for long-spined black echini, or sea urchins—formidable creatures, sea porcupines which recognize the presence of some possible enemy and attempt to hide among the weed by plunging deeper into its mazes. Splashes of white tell of a smaller sea urchin, and nearly every nook and corner of this sea forest is inhabited by these aggressive creatures.

The bottom of the sea along this rocky shore is a color scheme of marvelous beauty. Green is the predominating tone, but green in countless shades and expressions. Sometimes a short wiry weed covers the bottom, constantly being waved aside to display other and more attractive colors: weeds in purple and brown, rocks of lavender incrusted with a flaming red sponge, or a mass of pink barnacles from which rises the delicate mauve tracery of their breathing organs. This sea tapestry is constantly in motion, so has the appearance of changing light, shade, and tint, and displaying some new creature to the voyagers of the curious craft with windows looking down into the sea.

The window drifts past strange holothurians, like monster slugs lying on painted rocks, the *bêche de mer* of the Chinese, in which lives the glasslike fish, Fierasfer; by hordes of mimic flowers, Serpulæ, with crowns of red, white, blue, and seeming gold. The lightest jar on the boat and they are gone, to appear slowly, unfolding like flowers. Near them are tube-building worms, with slender organs; and out from beneath a rock wave the tentacles of the octopus, or perhaps the paper nautilus.

The animals of the hanging gardens are not confined to the kelp in its variety, or to the rocks of the bottom. The blue water where the sunlight enters brings out myriads of fairylike forms, poising, drifting, swimming, the veritable gems of the sea. Some are red as rubies, others blue, like the sapphire; some yellow, white, topaz, green as emerald; or emitting flashes of seeming phosphorescent light. Ocean sapphires they are called, minute crustaceans (Sapphirinæ), that are in such numbers that some lavish hand might have strewn the water with gems. Sweeping by, in classic shapes, are the smaller jelly fishes; crystal vases, moon-shaped bodies, so delicate that the rich tone of the ocean can be seen through them, then changing their colors to steely blue. Some are mere specters, a tracery of lace; others rich in colors and flaunting long trains. Now the glass floats over a giant four or more feet in length, its body white, blue, with dark chocolate lines radiating upward, while from below swing magnificent coils and flutings, the tail of this living comet that has been seen in Avalon Bay nearly thirty feet in length with a disk nearly two feet across, calling to mind the giant jelly seen by Louis Agassiz that was 125 feet long. Nearly all these pellucid craft move by slow flapping of the edge of the umbrella-like disk; but here is a jelly, the Physophora, that has a series of pumps by which it shoots along through the water. No more beautiful object can be conceived than this, ablaze with colors—pink, blue, and quicksilver—darting through the azure waters that form the interstices of the floating garden.

As the boat moves out into deeper water the purity of the aqueous sky is evident, as forty feet below the rocks are seen and the dim shapes of kelp leaves faintly outlined beyond. Here large fishes hide—the graceful sheepshead peculiar to the region, the male with enormous red and black stripes, blunt forehead, the lower jaw white. The female is a radiant creature with beautiful eyes and often red, brown, or white, the colors fading in confinement. These fishes are easily drawn near the boat by judicious display of bait and their graceful postures plainly observed.

Now the window is out over deep water to see the passing of a migratory school of barracuda, thousands of long slender pike-shaped fishes all headed in one direction, swimming slowly. Suddenly they disappear,

California Crawfish (*Palinurus interruptus*).

THROUGH A WINDOW OF THE SEA.

as though some shutter had been snapped, and onto the field dash a school of large sea bass, the game fish of this locality. Again the window approaches shoal water, and for several miles follows along the fishes' highway, regaling the passengers with an ever-changing panorama of marine scenery. Now it will be a shoal of myriads of blue perch (chromis), a fish that affects the kelp forest, and presents a sharp contrast to it in its vivid blue tint. These fishes delight to bask and sport near the surface, and the window appears full of them as it moves along. Rock bass, singly and in schools, are seen poised in the leaves of the kelp, striped brown and black; spotted rock fish, and here the radiant whitefish, as blue as the water, with long fins, while in the depths other interesting

forms appear, all slightly intensified, magnified by the glass.

In and out, in shallow, where the velvet-like rocks are near the surface; now offshore, following the trail of some vagrant shark, the shallow steamer moves, affording remarkable vistas of the sea and its secrets, and emphasizing the fact that a new method of study has been found in the field of popular science.

Zapon.

The price of shellac, which has been rising for some years, has at the present time reached such an inordinate height that efforts are being made in all directions to find a cheaper substitute. Such efforts, it is true, have so far had negative results, since nothing can entirely take the place of pure shellac, any more than of pure turpentine oil. The finest white shellac especially has been affected by the rise, and its solutions correspondingly; the price of spirits also shows a constant upward tendency, and, in view of the poor potato crops for some time past, we need not hope to see the quotations lowered at present. In this necessity, interest is being aroused in the article called zapon, a product which first appeared about 15 years ago. It makes an excellent coating for all metallic surfaces, German silver, nickel, copper, brass, or aluminium, can also be used on wood or paper, and is a substitute for all the varnishes known under the fancy names of metal varnish, brass varnish, silver varnish, antioxide, etc. Zapon has undoubtedly some advantages over the spirit varnishes; but the consumers are conservative, and, partly, perhaps, for convenience sake, keep to the old ways, and show little enthusiasm for zapon, which, however, is making its way forward, and is bound to have a prosperous future.

Zapon consisted originally of a solution of collodion-cotton in amyl-acetate and acetone, and it may be supposed that the property of collodion which makes it valuable in surgery for excluding air from open wounds, gave rise to the idea of making it the foundation of a sort of varnish. The ultimate constituent of collodion-cotton is cellulose, a substance formed from sugar and starch during the assimilation of matter by the protoplasm of vegetable cells. Pure cellulose can best be obtained from cotton, from which the foreign constituents are removed by extraction with water, alcohol, dilute acids, dilute solutions of potash, and finally with hydrofluoric acid, the object of the latter being to dissolve the silicic acid in the cotton. The residue is again cleansed with water. Filter-paper, in its manufacture, is put through this whole process, and may pass for pure cellulose. Cotton, purified in the way described, with all grease removed, and exposed for a certain length of time to the action of a mixture of one part of nitric acid and two or three parts of sulphuric acid, gives the product called pyroxyline, or gun-cotton, the well-known violent explosive. The cotton for the manufacture of zapon is prepared in the same way, and its structure is unchanged. It is scarcely necessary to observe that this material cannot be prepared by amateurs, but only in chemical works.

Amyl-acetate is the constituent of zapon which gives the agreeable odor of a fruit-essence.

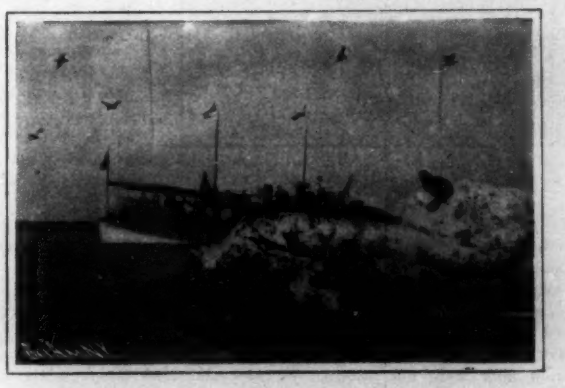
Acetone is a product of the dry distillation of wood, having likewise a pleasant odor, and boiling at 56 deg. C. From a mixture of amyl-acetate and acetone, in the proportion of 18:2, and by the solution of five parts of collodion-cotton, whose chemical name is colloxyline, in one hundred parts of this mixture, zapon is produced. The matter appears simpler than it really is; for not only is work with these materials accompanied with some danger, but the collodion-cotton sometimes obstinately refuses to dissolve, behavior which may be attributed to the manner of preparation. It is advisable for the wholesale consumer to procure from the chemical works concentrated solutions of collodion-cotton in amyl-acetate and acetone, and also the latter dissolving agent separately; the mass may then be diluted as needed. Smaller quantities of zapon may be procured ready for use.

Zapon can also be made from celluloid, since this material consists ultimately of cellulose. Accurately speaking, it is nitro-cellulose and camphor. The solution is made with the usual agents, or with sulphuric ether, and dilution is with amyl-acetate. Ordinary benzine may be added in small quantities, although this affects the quality unfavorably rather than otherwise. All varieties of zapon may be colored with the familiar soluble aniline dyes, and it is advisable to dissolve the dye in a mixture of equal proportions of amyl-acetate and acetone, and add to the zapon when ready for use. Zapon will not amalgamate with earth or mineral colors.

In working up the above described materials, an occasional shimmer of rainbow colors is an indication of too much dilution. This can be remedied by exposure to the air, whereby some of the liquid is evaporated. If zapon, on the other hand, is streaky, flaky, or crumbly, it needs dilution, but spirits must never be used for this. The zaponizing process must be carried on, if possible, in a warm workroom, and where cold metals are concerned, it is well to warm them. A varnish-furnace has the advantage that particles of grease or moisture adhering to the metal are removed at the same time, and cleanliness is a prime condition for the best work. Zapon may be applied to the surface like paint, or the objects may be immersed in it. It dries very quickly. Being very inflammable, it must not be brought near a lamp-flame, or an open fire. The odor is not injurious to health, though at first somewhat irritating to the throat.—Translated from the Farben Zeitung.

The Giant Spider Crab Dining.

A Large Jelly Fish. Specimens as Long as 30 Feet Have Been Seen.



Glass-Bottomed Boat Off Sea Lion Rocks.

Spotted Rock Fish (*Sebastodes vexillaris*).

In the Hanging Gardens. A Perfect Scene in the Kelp Beds of Santa Catalina Under Water.

THROUGH A WINDOW OF THE SEA.

There has long been a demand for some arrangement by which the amount of material remaining in a bolt of ribbon or cloth can be ascertained at a glance. As a means of doing this the suggestion was made that a tape be wound up with the ribbon, the tape being marked with inches, feet and yards, but when this was tried, it was found that there was a serious discrepancy in the respective lengths of the two pieces. This difficulty has now been overcome by slitting the paper tape at regular intervals, and passing the ribbon in and out through these slits. This innovation, which is the invention of a Chicago ribbon manufacturer, will not only be of great assistance in the shop, where the ribbon may be measured off in the required quantities without the use of a yard-stick, but will be also found to greatly facilitate the work of stock taking, which in the case of ribbons, cloths, and similar materials is a very tedious operation.

THOMAS A. EDISON AUTOMOBILING TO THE SOUTH.

It is undoubtedly true that the average person evinces as great an interest in the private lives and doings of prominent men as in their public labors and successes. For, naturally enough, a knowledge of the more intimate personal characteristics and a closer view of the life at home, at work, or at leisure appears to bring the celebrity closer to us and to make his achievements appeal the more strongly to the individual.

The accompanying photographs of Thomas A. Edison show the dean of the inventors of America, if not of the world, in situations that are as interesting as they are unconventional. They were taken during a vacation trip planned some time ago and carried out recently. It is not strictly correct to designate this automobile trip as a vacation, for the word vacation is almost unknown to the great electrician whose working days often last for eighteen or twenty hours. And even in this instance the vacation tour was undertaken with a view to study and investigation, and the causes that gave rise to it were these: For the last few years Edison has been working steadily and enthusiastically at his alkaline storage battery, and while he has succeeded in developing a cell that is decidedly superior to the lead accumulator for many purposes, a great deal still remains to be accomplished before his success can be called complete. In the course of his investigations Edison has employed and tested a great variety of different metals, and among these recently was cobalt. As this metal is comparatively rare, and consequently expensive, the inventor has been on the lookout for possible sources of cobalt-bearing minerals which would make it better available for his purposes.

It was reported that cobalt existed in considerable quantities in the neighborhood of Charlotte, N. C., and thereupon Edison dispatched three prospectors to search through this region for the metal. Favorable reports having been received from these investigators, Edison determined to see for himself whether or not the reports were warranted, and so undertook this trip. For several years past the inventor has been an enthusiastic automobilist, and he decided to make the journey from his home in Orange to Charlotte by means of his two White steam cars with which he last year accomplished the Glidden tour, though in a reverse direction from that taken by the various contestants. He strongly favors the steam machine for long and rough trips, and declares that it is far superior to the gasoline car for such purposes.

The party consisted of Edison, his son Charles, and a Mr. Miller, in one car, and two laboratory assistants in the second car. The machine driven by Edison was in the usual condition for touring with tonneau and Cape cart top. The tonneau of the second machine, however, was removed and replaced by a box-like structure in which was packed a complete camping outfit, baggage, provisions, and a small amount of laboratory apparatus for use in mineralogical investigations. Needless to say, provision was made for the repair of almost all possible injury to mechanism or tires. The tourists, of course, encountered tire troubles, but there were practically no difficulties with the engines. That the trip was rather strenuous will be understood by all those familiar with the roads in that section of the South traversed by the tourists. The departure from Orange was made on May 16 and from there the route lay through Philadelphia, Baltimore, Washington, through the Shenandoah Valley, over the mountains across Virginia, into North Carolina to Charlotte. The Shenandoah Valley and mountain trip is one that is not often undertaken, for the roads are usually unspeakable. Edison, however, revels in a tour of this kind and thoroughly enjoyed even the most difficult portions of the journey. Fortunately the weather was uniformly good, and rain and mud were not added difficulties. Gasoline was easily procurable along the route, and no trouble was encountered in supplying the engines with the water available.

Edison is unquestionably one of the most unassuming and democratic of our great men and he makes a splendid companion for such a trip. He sturdily objects to posing for pictures however, and the accompanying photograph of the inventor asleep was taken during a noon rest near Leesburg, Va. It is probably the first of Edison taken under such circumstances. The idea appeals to us as rather novel; our conceptions of Edison are usually of the inventor as very "wide awake." Wherever necessary the tourists camped alongside the road and only availed themselves of hotels or inns where such were reached without trouble. It is not the intent of the party to return in the same manner. The machines will be shipped north, and after a stay of several weeks in the region around Charlotte the party will return by rail.

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Mr. Edison Taking a Nap During a Noon Halt.

The Press Photo Co. **Leaving Washington by the Chain Bridge**

Fresh Air for Miners.

L'Illustration thus describes a new implement for securing this desideratum:

The Society of Mines at Courrières has just undertaken in shaft No. 4 a series of experiments with a new respiratory apparatus called pneumatogen. Every apparatus designed for allowing the stay in a deleterious environment must fulfill three essential conditions: exclusive communication of the respiratory organs with a reservoir of respirable gas; together with a light weight, sufficient capacity of this reservoir to supply a man for a certain time; elimination of the expired carbonic acid, which would poison the pure air. The pneumatogen, which seems happily to realize these three conditions, is based upon the method of the renewal of vitiated air devised several years ago by Mons. George F. Joubert. It consists of an India-rubber bag, worn in front, about waist-high, and supported by a strap passing up one side of the miner's chest, round his neck, and down the other side. Into this bag by means of a mouthpiece he "sends the products of respiration, which are compelled to go through two tubes containing grains of oxylith. The oxylith, or 'stone of oxygen,' has the property of retaining steam and carbonic acid, while setting free a corresponding quantity of oxygen. The vitiated air therefore finds itself renewed when it becomes stored in the bag. The experiments made at Courrières have given excellent results. The miners furnished with the new apparatus have been able to work more than two consecutive hours in shafts where the air was absolutely unrespirable."

Concrete piles of an unusual form have recently been tested in New York. According to the Iron Age they are made by spreading a layer of concrete on wire fabric to which longitudinal rods are attached at intervals. The fabric is immediately rolled up in a special machine of simple construction, and the pile then laid aside to harden. It thus contains, in addition to the fabric, any desired number of vertical rods. In a cross section of the pile the fabric lies spirally from the inside to the exterior of the concrete. If so desired any one of the rods may be made a hollow tube, thus allowing for the use of the water jet.

The Press Photo Co. **The Second Car Carrying the Luggage.**

A Stop Near Leesburg, Va. The Press Photo Co.

THOMAS A. EDISON AUTOMOBILING TO THE SOUTH.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

TELEPHONE SYSTEM.—C. L. BOYCE, Detroit, Mich. The inventor's objects are to carry out various sub-operations of receiving call-signals, the withdrawal of said signals in due season, and appropriate display and withdrawal of supervisory and disconnecting signals in a highly efficient manner; to dispense with relays in main circuit-conductors of the switchboard; to control the supervisory signals without the use of shunt-circuits, and to provide that the relays concerned in operating the call and supervisory signals of each substation-circuit shall belong to such line-circuit, and independent switchboard circuits, thus aiding in avoidance of faults and facilitating their location and removal.

Of Interest to Farmers.

COMBINED SEPARATOR AND BAGGING DEVICE FOR GRAIN.—T. C. HENNINGER, Markham, Texas. One of the principal objects of the invention is to provide an attachment for threshing-machines through the medium of which grain or other cereals may be taken directly from the machine and the lighter or inferior particles separated therefrom and the heavier or superior particles thereof delivered or loaded into bags or other receptacles therefor.

Of General Interest.

LATHING SYSTEM.—E. NIDDS, New York, N. Y. The invention pertains to lathing systems and more particularly to those employing metal. Its principal objects are to provide a convenient lath and to furnish a simple and strong construction. The system eliminates all auxiliary securing means either for the laths or bars. The invention is equally applicable to segmental arches as to ceilings. In fact, the arrangements in which it may be used are limited only to the capabilities of bending the bars and conforming the lathing.

WINDOW FRAME AND SASH.—R. F. NICHOLS, Oakland, Cal. One purpose of this improvement is the provision of such a construction of window-frame that the window-sashes may be singly or collectively swung within the frame a sufficient distance to enable the outer faces of their panes to be cleaned without the operator leaving the room or leaning from the window.

CONNECTING DEVICE FOR WHEEL-FELLIES.—J. R. HUGHES, Chama, New Mexico Ter. In the form of the improvements in this invention a specially-constructed device is employed for the adjacent ends of the sections of the felly or wheel-rim, comprising complementary ferrules or caps, each of special construction, and co-operating with the other in the production of a close joint between the sections, which is highly resistive to strains from all directions, besides preventing splitting of the sections.

GARMENT-SUPPORTER.—H. P. COULTER, Philadelphia, Pa. In this instance the invention pertains to improvements in devices for attaching suspenders and drawers to trousers, the object being to provide a fastener to be used in place of the usual buttons, the device being so constructed that it may be easily and conveniently secured in position.

COLLAR-SUPPORTER.—MARGUERITE CONNELL, New York, N. Y. This supporter for lace collars or collars made from thin material is simple and economic of construction and capable of being expeditiously and conveniently applied to the collar or removed when the collar is to be washed. It will hold the most flimsy collar in an upright position, but will not cause discomfort to the wearer, injure the collar, or be visible when the collar is worn, even though considerable open-work is a feature of the collar.

Hardware.

COMBINATION-TOOL.—J. P. MCGINNITY, New York, N. Y., and E. H. WINKLER, Krebs, Indian Ter. The purpose of this improvement is to simplify the construction of a combination-tool, especially one which combines the functions of a brace and a wrench; and a special object is the provision of means for securing the handle of the brace to the spindle thereof when the handle is being used in connection with the wrench.

Pertaining to Recreation.

AMUSEMENT APPARATUS.—C. D. BUNNELL, New York, N. Y. It is sought in this improvement to provide a wheel with certain peculiarly-arranged elements, causing a car or other vehicle to be raised by the rotation of the wheel from the bottom periphery thereof upward to its center and thence by means of a switch to have its movement reversed and gradually lowered from its center back to the lower periphery of the wheel, which operation is carried on solely by the rotation of the wheel and coaction of said peculiar elements with the car or other vehicle referred to.

GAME APPARATUS.—W. SANDBERG, Chicago, Ill. The invention refers to game apparatus, its principal objects being to provide an entertaining game in which the ball is delivered from a chute and directed in transit over a ribbon against pieces or ten pins placed in position on a support, in the successful playing of which considerable skill may be displayed. The apparatus though separable from the table upon which it is mounted is adapted to be knocked down into compact shape for storing away.

Pertaining to Vehicles.

VEHICLE-BRAKE.—J. W. SMITH, Congress, Arizona Ter. The invention refers to improvements in brakes for vehicles, such as road-wagons, trucks, and the like, the object being to provide a brake of simple construction, that may be easily adjusted to a vehicle, that may be readily applied by suitable pressure to the rear wheels, and having no parts liable to get out of order.

WAGON-TOP.—J. POHLIG, New Orleans, La. There is provision in this invention for a simple and convenient means for operating and adjusting side curtains to serve as sunshades or to entirely close the sides, the operating devices being so constructed as to be readily attached to any form of delivery or similar wagon.

VALVE.—A. L. MOSS, Sandusky, Ohio. This new valve is more especially designed as a controller-valve or check-valve, for controlling the passage of compressed air or other fluid, and when closed being capable of holding a fluid pressure exceeding, say, sixty or seventy pounds, for a long period and without danger of leakage, thus rendering the valve exceedingly efficient for use in pneumatic sanding devices for automobiles and the like as shown and described in Letters Patent of the United States recently granted to Mr. Moss.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 8120.—For address of the U. S. Cutlery Co.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 8121.—For manufacturers of a soldering iron with the gasoline tank in the handle.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 8122.—Wanted, manufacturers of rotary, gas, gasoline and oil engines and turbines.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 8123.—For manufacturers of machinery that grinds leather scraps into a pulp; also manufacturers of leather door knobs.

Metal Novelty Works Co., manufacturers of all kinds of light Metal Goods. Dies and Metal Stampings our Specialty. 43-47 S. Canal Street, Chicago.

Inquiry No. 8124.—For manufacturers of small screws and nuts, such as used in scissors and shears.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company. Foot of East 138th Street, New York.

Inquiry No. 8125.—For manufacturers of an instrument called the Automatic Telegraph Transmitter.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery tools, and wood fiber products. Quadriga Manufacturing Company, 13 South Canal St., Chicago.

Inquiry No. 8126.—For manufacturers of a machine for moving sand and shavings.

Automobile experts are in constant demand at high salaries. Our seven weeks' course is the most thorough and practical. Fitting men to drive, handle and repair. Day and evening classes. Special course for owners. New York School of Automobile Engineers, 146 West 58th Street, New York.

Inquiry No. 8127.—For manufacturers of positive rotary air compressors, delivering from one to five pounds pressure.

WANTED.—The partial services of several men who have facilities for observing, and ability to comprehend the performance and good features of different automobiles. The work will occupy little time, and be chiefly in the nature of correspondence. Address Thomas B. Jeffery & Company, Kenosha, Wis. Department of Construction.

Inquiry No. 8128.—For manufacturers of clock systems, consisting of one master clock controlling any number of secondary clocks.

Inquiry No. 8129.—For manufacturers of novelties and specialties suitable for selling to canvassing agents

Inquiry No. 8130.—For manufacturer of Edison's patent electric rat trap.

Inquiry No. 8131.—For manufacturers of repairs for the Curtis & Mitchell foot power printing presses.

Inquiry No. 8132.—For manufacturers of a cheap substitute for celluloid.

Inquiry No. 8133.—For manufacturers of dairy machinery for making butter and cheese, capacity 10,000 liters of milk.

Inquiry No. 8134.—For parties installing incubators of different sizes, capacity 2, 5 and 10,000 chickens.

Inquiry No. 8135.—For parties installing large drying chambers of the most perfect kind for drying fruits, with a capacity for a very large number of fruits.

Inquiry No. 8136.—For manufacturers of grinding mills for preparing flour, barley, oats, malt, peas, lentils, beans, maize, etc.

Inquiry No. 8137.—For manufacturers of small looms and mechanical spinning machinery for preparing silk fabrics, etc.

Inquiry No. 8138.—For manufacturers of small looms and mechanical spinning machinery for preparing hemp, jute, linen, ramie, etc.

Inquiry No. 8139.—For parties installing machinery on a large scale for preserving fruits and vegetables, such as asparagus, tomatoes, green peas, peaches, pears, apples, grapes, etc.

Inquiry No. 8140.—For parties installing machinery for drawing oil from peanuts, almonds, olives etc.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

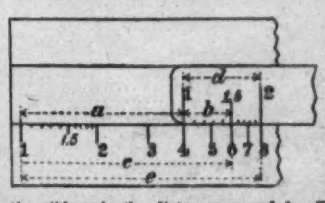
Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9991) R. W. asks for a rough method of estimating the horse-power of a steam engine. A. Multiply the square of the diameter of the cylinder in inches by 0.7854, and this product by the mean engine pressure, and the last product by the piston travel in feet per minute. Divide the last product by 33,000 for the indicated horse-power. In the absence of logarithmic formulæ or expansion table, multiply the boiler pressure for ¾ cut-off by 0.91, for ½ cut-off by 0.85, ⅜ cut-off by 0.75 3-10 cut-off by 0.68. This will give the mean engine pressure per square inch near enough for ordinary practice, for steam pressures between 60 and 100 pounds, always remembering that the piston travel is twice the stroke multiplied by the number of revolutions per minute.

(9992) B. J. W. asks for information concerning India-rubber production. A. India rubber is the product of many euphorbiaceous plants. We get most of it from the Brazils and Central America. In Brazil it is obtained from the *Siphonia elastica*, which grows to a height of between fifty to sixty feet, and in Central America it is obtained from *Castillos elastica*. Most of that we now use comes from Central America, where the juice is simply collected into cups, from incisions made in the bark. To coagulate the milky juice and convert it into rubber fit for exportation, the juice of a vine called achuca is mixed with it, and so powerful is its action that five or six minutes is sufficient to produce coagulation. The Brazilian method slightly differs. The juice is first collected in clay bowls, it is then smeared over various shaped molds, made also in clay and taking the form of bottles, balls, spindles, etc. Successive coats are laid on, each one having previously been allowed to thoroughly dry, either in the sun or the smoke of a fire, which blackens it. When a sufficient thickness is obtained, the clay is washed out, leaving the India rubber ready for exportation. The trees yield twenty or thirty gallons of juice, and when we consider that each gallon will produce two pounds of market India rubber, the harvest is not so bad. Other trees producing caoutchouc are *Siphonia brasiliensis*, *S. lutea* and *S. brevifolia*.

(9993) H. B. asks for a formula for insulating material. A. Linseed oil, 2 parts; cotton seed oil, 1 part; heavy petroleum, 2 parts; light coal tar, 2 parts; Venice turpentine, ½ part; spirits of turpentine, 1 part; gutta percha, 1-6 part; sulphur, 2 parts; heat the oils separately to about 300 deg. F.; cool to 240 deg., and mix in the other materials, the sulphur last. Heat to 300 deg. F., for about an hour or until the mixture becomes pasty, and on cooling is soft and elastic.

(9994) M. D. says: I have lately bought a slide rule, and not knowing how it works I thought you could explain its operation. A. The slide rule is a graphical logarithm table. If you understand the use of logarithms, you ought to be able to work out the principles of the slide rule. When we wish to multiply two numbers, we add together their logarithms and find the number corresponding to the sum. Thus if we wish to multiply 4 by 1 5/10, we add together

on the slide rule the distances *a* and *b*. The sum is *c*, which corresponds to 6. If we wish to multiply 2 by 4, we add together *a* and *d*. The sum is *e*, and number corresponding is 8. The slide rule takes no account of the decimal point. The person using it is obliged to keep track of this in his head, and add to the figures given by the slide rule whatever ciphers may be needed to make the decimal point come in the right place. For more definite information we would refer you to the booklets published by the dealers in slide rules.

NEW BOOKS, ETC.

STEAM TURBINES. Their Development, Styles of Build, Construction, and Uses. By Wilhelm Gentsch. Translated from the German by Arthur R. Liddell. New York: Longmans, Green & Co., 1906. 8vo.; pp. 375; 637 figures; 19 plates. Price, $6.

It is not only the technical men who are concerned with the progress and development of the steam turbine, but a keen interest is also manifested by the general public as well. Unfortunately, the majority of works on this subject, by reason of their free use of mathematics and technical terms, are much too involved to be of interest to the lay reader. It is with the special purpose of meeting the needs of the non-technical man that the present volume on steam turbines has been written. The work is very complete, every typical turbine being fully described, but in so simple a manner as to be intelligible to all. So complete is the work, that it will be of great value to the specialist as well as to the layman. The book opens with a brief historical sketch of the steam turbine. The subject is then dealt with under the following divisions: Pressure Turbines; Velocity Turbines; and Combined and Velocity Turbines. Following this are a number of chapters which cover various constructional details and special features of different turbines. Finally, there is a chapter on Steam Turbines for Dynamos, another chapter on Turbine Pumps and Blowers, another on Steam Turbines for Land Vehicles, and a final chapter on Turbines for Use on Shipboard.

CONCRETE-BLOCK MANUFACTURE. Processes and Machines. By Harmon Howard Rice. New York: John Wiley & Sons, 1906. 8vo.; pp. 152; 46 half-tone cuts. Price, $2 net.

Notwithstanding the tremendous advances which have been made within recent years in the concrete industry, the literature on the subject is still comparatively limited. This book will be welcomed by many interested in concrete and its uses as practically the first which treats the subject in a comprehensive and painstaking manner. The author discusses concrete, cement, aggregates, water, and other ingredients for blocks, and explains the methods of proportioning and mixing them. Other phases of the question, such as general processes of manufacture, are given due weight in various chapters. However, the book unfortunately does not state in a sufficiently definite manner that the entire industry is at present in a rather formative condition, that almost all of the questions involved are still open to discussion, and that many diverse opinions are held by different experts.

MARINE BOILERS. Their Construction and Working, Dealing More Especially With Tubulous Boilers. Based on the Work of L. E. Bertin, late Chief Constructor of the French Navy. Translated and edited by L. S. Robertson. New York: D. Van Nostrand Company, 1906. 8vo.; pp. 658; 350 illustrations. Price, $5.

Notwithstanding the large number of really excellent books covering the subject of the marine boiler at present available, this volume can be incorporated with advantage in any technical library. M. Bertin's recognized standing as a naval engineer, both here and abroad, would alone be sufficient to command consideration for his work; but the intrinsic value of the book itself really makes this unnecessary. The marine boiler is treated in the greatest detail; and while mathematical discussions are avoided as far as possible, this is not done at the expense of the theoretical side of the subject. The illustrations are up-to-date, and will be found of great value in the perusal of the text.

SHAFT GOVERNORS. By W. Trinks, M.E., and C. Housum. New York: D. Van Nostrand Company, 1906. 32mo.; pp. 97. Price, 50 cents.

Notwithstanding the extensive use of the shaft governor for nearly a quarter of a century, the discussions in technical literature of this very useful mechanism are altogether too limited. The book is really the result of collections of notes and rules used by the authors in the design and adjustment of engines, and it relates to the statics of shaft governing alone. The volume does not completely fill the want in various text-books on engine design, as far as shaft governors are concerned, but students and engineers in practice will find many valuable suggestions within its pages. A revised and enlarged edition would seem advisable; for not only is the space too limited, but there are numerous typographical errors to be corrected.

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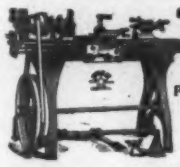

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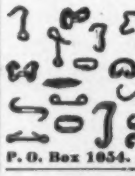

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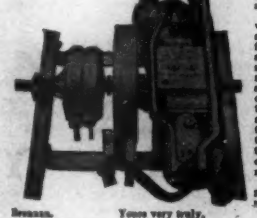

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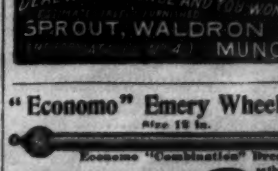

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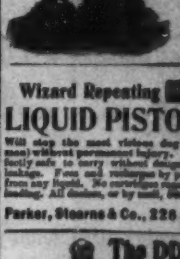

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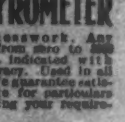

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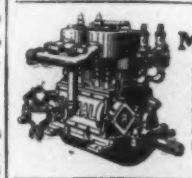

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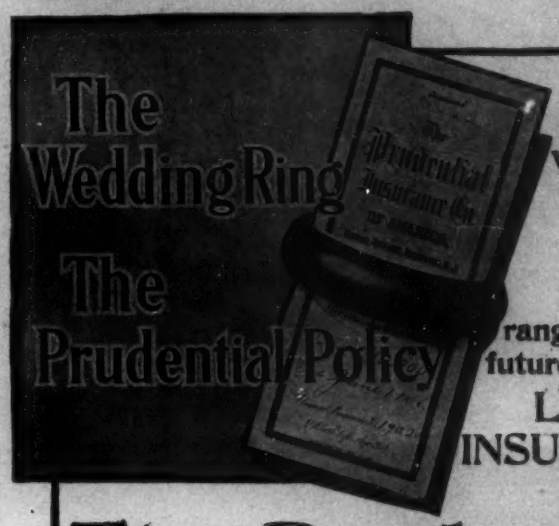

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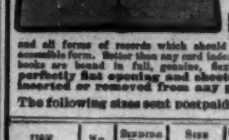

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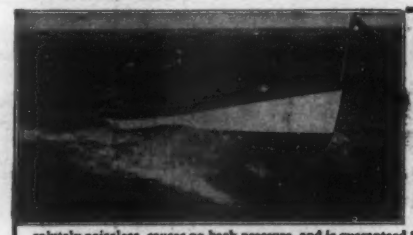

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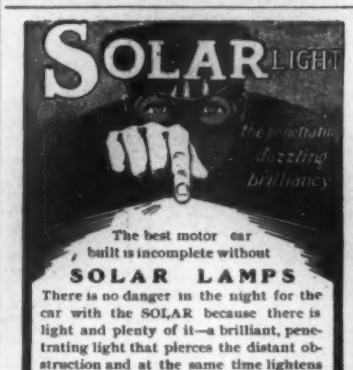

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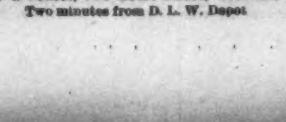

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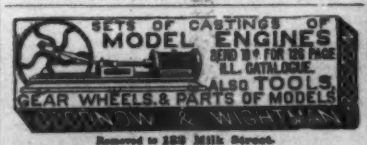

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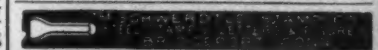

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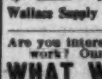

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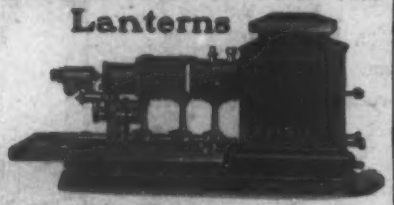

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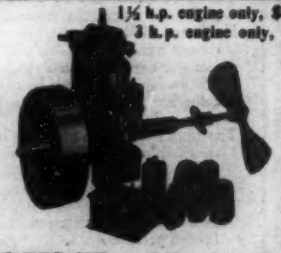

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